SNAKES OF INDIA

P.J. DEORAS

SHOUT
SHARE
IT

SNAKES OF INDIA

GREEN PIT VIPER (*Trimeresurus gramineus*)
(Taking lever-like action of neck after attack)

India – The Land and the People

SNAKES OF INDIA

P. J. DEORAS

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PREFACE TO THE FIRST EDITION

SNAKES have formed an object of awe and curiosity in all lands. In India they have been associated with mysticism, apart from being objects of fear. There have been writings about snakes in old Indian literature. In these writings the allusion is given primarily to the hooded snake, the Cobra. There are records in the Ayurved which pertain to snake venom, particularly the Cobra venom. Some of this literature has tried to give a rough knowledge about snakes, the effect of the venom, the antidotes and the probable uses of the poison.

In modern times a number of articles on snakes have appeared in the beginning of this century, particularly in the records of the Bombay Natural History Society. Col. Wall, Dr. Cazaly and Dr. Boulenger were probably the first writers to give an account of Indian snakes in a book form. These books form an important landmark on this topic. The most authoritative book on Indian snakes was written by Dr. Smith in the Fauna of British India series in 1943, and to this day this volume forms the main plank of classification and details about Indian snakes.

A number of scientific workers particularly Dr. B.C. Mahendra and Mr. McCann have been working on the different aspects of snake structure and life in India. Col. Gharpure in his book on snakes of India, Burma and Pakistan has tried to collate in a short volume the different aspects of Indian snake life. Apart from this, for a layman, a medical practitioner and a student, hardly any book is available whereby he could satisfy his curiosity about snakes, without going into details about the classification and other scientific aspects.

This book is an attempt to create an understanding about snakes. It is not a scientific treatise for classification. The readers are requested to refer to Dr. Malcolm Smith's *Fauna of British India* for details of classification and identification of Indian snakes. This book of Dr. Smith has been my source, and I have drawn extensively from its pages to present a simple pattern about a few snakes in the Indian Union only. In the third chapter I have drawn extensively from various sources along with the personal observations and data from the work carried out on snakes for the last decade or so. Dr. Klauber had very graciously gone through the booklet, *Snakes and How to Know Them*, published by the Director of Publicity, Government of Bombay in 1959. It was during a meeting with him at San Diego and at his suggestion that a number of details were recorded of snake-life in India. Dr. Klauber's monumental book, *Rattle-snakes* is an inexhaustible source of general information on a number of snakes and it has been a great source of inspiration and guide to me in writing the present book.

The present booklet therefore is only an attempt by me to thread these pearls of information, so that the reader in general gets to know snakes, nay gets to appreciate a snake as an integral part of nature without the fear, mysticism and fearsome folklore about them. The cobra, for example, is our national heritage and a symbol of Indian culture through the ages. The book contains a description of snakes in India, treatment of snake bites, hints to students, and in the last chapter are given simple keys to classify them into families and know some general details about some important non-poisonous and poisonous snakes of the Indian Union. I have added many photographs to make the book interesting.

The credit for this attempt goes to Dr. B.V. Keskar, without whose persuasion and encouragement this book would have never seen the light of the day. I express my sincere thanks to him.

In the preparation of the material and pictures for this booklet Mr. Vad, and Mr. Chaturvedi, my colleagues, were always greatly helpful. Mr. Karnikar obliged me by assisting in taking pictures at Sanchi. Shri Sant Panchlegaonkar very

kindly loaned the block showing a snake with the late Pandit Nehru. Shri Mohan Paralkar kindly helped me in executing the realistic line drawings inserted in this book. Messers. Kalanidhi of Dadar promptly executed the photographic work. Shri Naik very kindly helped me in the initial stages and Dr. K.N. Vaidya went through the proofs. The Times of India Press has rendered valuable ungrudging assistance in the printing of this book. To all these I owe a debt of gratitude.

Lastly, whatever is achieved in this book is largely due to my association and work with the Haffkine Institute. I will ever remain thankful to this renowned centre of scientific learning and also to the Government of Maharashtra for its permission.

Bombay,
February, 1965

P. J. DEORAS

PREFACE TO THE SECOND EDITION

SCIENCE is advancing everyday and newer facts are coming to light. This book, first published in 1965 and reprinted again in 1970, had to be recast to take in newer knowledge to throw light on this subject. The book has been revised keeping in view the requirements of the lay people, medical practitioners and college students. I am thankful to my readers for continuously writing to me and asking questions on the subject. District Gazetteers of the Government of Maharashtra and that of Goa, Daman and Diu, graciously assisted me for the last six years in collecting the field data on the snakes and the observations on belief and mysticism about snakes and charms in the various districts of Maharashtra and Goa. I owe a debt of gratitude to them. The National Book Trust has given assistance in revising the book. I am thankful to them.

Bombay,
February, 1977

P. J. DEORAS

PREFACE TO THE THIRD EDITION

DURING the last six years there have been a number of incidents that brought the story of snakes to limelight. There was the first international congress on snakes held in Caracas in 1976, wherein scientists from different nations decided to meet periodically and review the progress done in the field of the taxonomy of snakes and the fractionation of its venom. In India a number of young enthusiasts have started collecting and exhibiting snakes in a snake farm. Earlier this year a young man tried to establish a record by staying with poisonous snakes for 72 hours. This incident has aroused a great curiosity and other young Indians are turning towards snake exhibitions for a living. Government of Maharashtra is putting up a snake farm in Bombay. The Baroda Corporation is also putting up a snake show in their public gardens. Thus there would be a demand for more knowledge about snakes at the general level. In this connection there has been a demand from the business community for permission to export snake skins, and an extraordinary number of 5 million skins are awaiting the signal to be sent out of the country. This will create a dangerous move since mass slaughter of snakes may take place to earn some foreign exchange. The meagre snake fauna is in danger, and it is time people are informed about the effect on ecology and the benefits that would accrue if snakes are understood and preserved. This fourth edition is therefore an attempt in this direction. The National Book Trust deserves our thanks for bringing out this edition in record time.

Bombay,
June, 1981

P. J. DEORAS

PREFACE TO THE FOURTH EDITION

DURING the last seven years, there have been a number of research studies and these have been incorporated in this book "Snakes of India". The researches show that the parotid gland secretions even of the so called non-poisonous snakes as in Colubridae is showing toxicity in human snake-bite cases.

In spite of different books, people still come forward to cure snake bite cases by incantations and believe in super-natural power in snakes. This had to be counteracted by giving some experimental data in this book. Vernacular names of some snakes from Bengal as well as newer spottings have been recorded.

The book was ably reviewed by Dr. Howard M. Smith in U.S.A. His comments bring out some details and pictures about snake worship in India for incorporation in this edition as it would interest not only foreign visitors, but also many Indians who are oblivious of the fact that snakes in India indicate a unity of culture through the ages.

I am thankful to the National Book Trust, New Delhi for their promptness in bringing out the current edition in record time.

Bombay,
June, 1990

P. J. DEORAS

CONTENTS

Chapter		*Page*
	PREFACE	V
I	SNAKES AND THEIR IMPORTANCE	1
II	SNAKES IN INDIAN CULTURE	17
III	KNOWING THE SNAKES	32
IV	CLASSIFICATION AND IDENTIFICATION OF SNAKES	79

NON-POISONOUS SNAKES

Typhlops braminus (The common blind snake)	107
Uropeltis ocellatus	108
Python molurus (Indian python)	109
Eryx conicus (Sand boa)	111
Acrochordus granulatus (Wart snake)	112
Elaphe helena (Trinket snake)	113
Ptyas mucosus (Rat snake)	114
Coluber ventromaculatus (Racers)	115
Coluber diadema (Diadema snake)	115
Liopeltis calamaria	116
Coronella brachyura	117
Oligodon venustus (Wolf snake)	117
Ahaetulla grandocullis (Bronze-back snake)	118
Chrysopelea ornata (Golden tree snake)	119
Lycodon aulicus (Common wolf snake)	120
Dryocalamus nympha (Bridal snake)	120
Natrix piscator (Checkered keel-back)	121
Natrix stolata (Buff striped keel-back)	122
Macropisthodon plumbicolor (Green keel-back)	123
Boiga trigonata (Cat snake)	124

Dryophis nasutus (Common green whip snake) 124
Psammophis leithi (Sand snake) 126
Cereberus rhynchops (Dog-faced water snake) 126
Elaschistodon westermanni (Indian egg-eater) 127

POISONOUS SNAKES

Bungarus caeruleus (The common krait) 129
Bungarus fasciatus (The banded krait) 130
Bungarus niger (The black krait) 131
Callophis melanurus (Slender coral snake) 131
Callophis nigrescens (Coral snake) 132
Naja naja (Cobra) 133
Naja hannah (Hamadrayad or King Cobra) 137
Hydrophis caerulescens (Sea-snake) 138
Vipera russelli (Russell's viper) 140
Echis carinatus (Saw scaled viper) 142
Ancistrodon himalayanus (Himalayan pit viper) 144
Trimeresurus gramineus (Bamboo pit viper) 145

REFERENCES 147
INDEX 151

LIST OF ILLUSTRATIONS

BLACK AND WHITE

Plates

1. A fight between a Cobra and a mongoose
2. Cobra snake being charmed by playing on gourd
3. Falcon Bird
4. Kaliya mardan
5. Shesh-shai
6. Hooded serpent images under a Ficus tree in Karnataka State
7. Nega raja with seven-headed cobra head-gear
8. Sanchi (main stupa) Torana on the western gate
9. Collection of cobra snakes of Shirala
10. Snake God temple image of Manarshala
11. A patient of Psorosis praying at Mahashala
12. Worshipping a cobra on a Nagpanchami day
13. Sanchi (small stupa at the enterance of the main stupa)
14. Sanchi (small stupa at base and west of main stupa)
15. X-ray photograph of a two headed king-snake
16. a. Anal spurs as appendages of a python
    b. Internal appendages in Typhlops
17. "Horns" (on the head of Pseudocerastes persicus)
18. Keeled and Serrated "Saw scaled" scales of Echis carinatus
19. "Hairs" (moustache) planted on a cobra head
20. Extraction of a cobra venom
21. Extraction of Venom from Russell's viper
22. Damage caused to the hand of a patient after a bite by a viper
23. Rat snake tying a "scout" type of knot
24. Snake "jewel"
25. A snake round the neck of late Jawaharlal Nehru

26. The "pit" in the green pit viper
27. Showing penis sticking out
28. Boiga gokool
29. Photograph showing the comparative sizes and shapes of fowl egg, rat shake egg, cobra egg, krait egg and viper embryos
30. Tails of different snakes
31. Coral snake (Callophis melanurus)
32. Typhlops braminus
33. Oligodon (Oligodon vensustus)
34. Oligodon arnensis
35. Common Wolf Snake (Lycodon aulicus)
36. Skins of cobra showing the different marking pattern on the head
37. Hood of cobras
38. Echis carinatus
39. King cobra (Naja hannah)
40. King cobra hatching out of an egg
41. Russell's viper
42. Cannibalism, Russell's viper eating its young one

COLOUR

Green Pit Viper (*Trimeresurus gramineus)* Frontispiece
I. The Common Indian Python (*Python molurus*)
II. Indian Python along with Sand Boas
III. Sand Boa (*Eryx conicus*)
IV. The Rat Snake (*Ptyas mucosus*)
V. Diadem Snake (*Coluber diadema*)
VI. Checkered Keel-Back (*Natrix piscator*)
VII. (a) Cobra (*Naja naja*)
(b) Cobra (Dorsal view of hood)
(c) Cobra (Ventral view of hood)
VIII. Whip Snake (*Dryophis nasutus*)
IX. Common Krait (*Bungarus caeruleus*)
X. Banded Krait (*Bungarus fasciatus*)
XI. Russell's Viper (*Vipera russelli*)
XII. Green Pit Viper (*Trimeresurus gramineus*)
XIII. Cat Snake (*Boiga trigonata*)

Except for the following all the photographs in this book are by the author.

Black and White

1. The San Diego Zoological Society — Plate No. 15
2. Dr. Oliver, New York Zoological Garden — Plate No. 40
3. Shri Sant Panchalegaonkar — Plate No. 25
4. Shri Mukual Dey — Plate No. 7
5. Shri Vad Plate Nos. 16, 18, 23, 26, 32, 33, 34, 37, 38, 39

Colour

Shri G. Nanja Nath Fig. Nos. I, II, IV, VII, IX, X, XI, XII and Frontis-piece

CHAPTER I

SNAKES AND THEIR IMPORTANCE

NEARLY 240 million years ago were seen the creeping animals called Reptiles. They became enormous in size and predominated till the time mammals were about to be born. Those were the days when giant fern trees formed luxuriant forests and the seed-bearing plants were about to come. The dying tree ferns later on became the fossil fuels of our generation and the 15 orders of predominating reptiles are survived by only 5 in the present day world. These reptiles now number about 6,000 species. They are made up of 25 species of order *Crocodalia*, consisting of crocodiles, alligators and gharials. Second order *Chelonia* includes 250 species of tortoises, turtles and terrapins. The third is *Lacertalia*, consisting of 3,000 species of lizards, gekos and monitors, and the fourth are *Ophidia*, the Snakes. The Tuatara of New Zealand with its 'third' eye is the solitary species under *Rhynchocephalia* forming the fifth order, in New Zealand.

Reptiles are now found on land and in water and only one species, Dracovolans, a lizard, can imitate a flying motion in the air. *Ophidians* are the creeping animals commonly known as snakes. There are nearly 2,000 species of snakes on this Earth and they predominate the warm climates and lush regions of the tropics. There are no snakes in the Arctic, New Zealand and Ireland. In India there are 216 species[1] of snakes of which about 52 are those whose bite may cause some toxic symptoms in man. It is this fear of snake-bite, apart from the creeping motion and cold body that has created a prejudice

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[1]**Smith**, M. (1943), *Fauna of British India*, Vol. III 'Serpents'

against snakes. Man was born only about 4 million years ago, and to survive he must have had to fight against many odds. Reptile-Fear is one of these odds, and somehow this constitutes his abhorrence for snakes.

The number of persons bitten by snakes in India was calculated to be 2,00,000 annually. About 15,000 are said to have died due to snake-bite in 1954.[1] In 1969, some data were collected to show the number of deaths due to snake-bites in different parts of India.[2] The following table narrates these figures :

Snake-bite Cases in India in 1969

State	*Cases*	*Deaths*
Jammu & Kashmir	832	33
Punjab	28	7
Himachal Pradesh	27	15
Haryana	259	8
Uttar Pradesh	1,351	84
Bihar	899	21
West Bengal	7,234	488
Nagaland	64	1
N.E.F.A.	11	1
Orissa	895	27
Madhya Pradesh	1,612	20
Rajasthan	1,426	62
Gujarat	2,274	62
Maharashtra	922	14
Andhra Pradesh	141	23
Karnataka	682	36
Goa, Daman & Diu	230	15
Tamil Nadu	968	31
Pondicherry	135	10
Kerala	1,142	361

The figures given in the above table have to be compared to the total population and area of India and it would then appear that this mortality is less than 0.0005 per cent. The figures of snake-bite cases are regularly collected by the

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[1]Swaroop, S. and Grab, B. (1954) Bull,W.H.O. 10(1) : 35.
[2]Vital Statistics (1969), Government of India.

Directorate of Public Health, Government of Maharashtra. Total number of mortality due to snake-bite from 1960 to 1971 was 498, 809, 905, 937, 862, 985, 1,032, 1,047, 1,145, 1,093, 1,103 and 1,403 respectively for the 26 districts of Maharashtra.[1] Thus, in 1971 there were only 1,403 recorded deaths due to snake-bite in the 26 districts of Maharashtra spread over an area of 3,07,762 square kilometres and having a population of 5,04,12,000, which means only 0.002 per cent of the population. There is no specific data available of death from snake-bite in livestock and other domestic animals. Sawai and Homa (1976)[2] have mentioned that the total number of patients that visited Government hospitals and dispensariees for snake-bites were 24,000 in 1969, and that only 1100 (4.6 per cent) of these were fatal in Uttar Pradesh, Maharashtra, Kerala, Tamil Nadu and West Bengal. They further mention that 66.1 per cent of the bites occured in males and 33.9 per cent in females. The largest number of bites occured in the age group between 10 and 19. The maximum number of bites occured during warmer months especially in the monsoons. The maximum number of bites took place between 6 p.m. and midnight. The most vulnerable part of the body were lower extremities (72.7 per cent) especially the feet (41.4 per cent). The next in order were the fingers of hands (25.2 per cent), while the head bites were as low as 0.6 per cent only.

Numbers

The intensity of the distribution of snakes in any particular area has not been correctly worked out. The fear complex in man always quotes a swollen figure. The *Times of India* (May 1, 1863) had quoted the loss due to snake-bite as "incredible" Old records of Ratnagiri district in Maharashtra State quote that as many as 2,79,507 snakes (*Echis carinatus*) were destroyed from 1875 to 1877.[3] Recently Government of India have permitted the export of 1,00,000 live snakes and

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[1]Public Health Department, Govt. of Maharashtra (1971).

[2]*Sawai Y.* and *Homa M* (1976), *Snake Bites in India : Animal, Plant,* and *Microbial Toxins, Vol. 2 (1976)*, Plenum Publishing Corporation, New York.

[3]Deoras, P.J. & Vad, N.E., J.Uni. Bombay, 34 : 41. 1961.

12,00,000 snake skins per year.[1] However, in 1955 systematic collections were made for 13 days in the month of August at Deogad in Ratnagiri district of Maharashtra. The area covered was 4 square miles each day, for one hour only, and in this period 41 *Echis carinatus* were recovered from under stones in 13 days.[8]

Importance in Rodent Control

It should be realised that while the farmer is busy ploughing his fields during rains, the snakes control the rats in the farm and in storehouses. Rats do more material damage to food and health in our country than snakes. Dr Kunhardt had estimated in 1919 that the damage caused by rats to foodgrains and property in India in 20 years was about 1,241 crores,[2] and that the probable "population of rats in India may be 8,000 million". World Health Magazine, 1967, recorded the total loss of stored cereals by rats to be 33 million tons a year. If the rats could be controlled in the town of Bombay, the food available would feed 9,00,000 people for 12 months.[3]

As compared to the deaths caused by diseases and animal-bites, mortality in human beings due to snake-bites is very low. For example, 43 million people died of plague in Western Europe and in London alone 10,000 people died per week during 1665. In India, 2,47,015 people died of plague per year during various years on an average from 1898 to 1947.[4] In Bombay, it was estimated that 20,000 persons were admitted to hospitals for rat-bite fever alone in 1958; none of these was fatal.[5] The American magazine,[6] Time, wrote that the rat-population of New York city was 90-100 million and that their Government was trying to enact a rat-control bill for 540 million dollars. Rat damage to food and crops in India is estimated to be 750 crores of rupees per year.[7]

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[1]Government of India, Ministry of Agriculture, Personal communication, 1972.
[2]Kunhardt, J.C.G., 1919, Proceedings 6th Indian Science Congress : 291.
[3]World Health Magazine, April 1967, pages 3-22.
[4]Pallitzer, R. (1954); W.H.O. Monograph On Plague (24).
[5]Haffkine Institute (1958) Report on Rat damage.
[6]*Time* (American Weekly Magazine) Asia edition (1967) August 11th p. 12.
[7]Fourth Five Year Plan (1971) Pesticide Manufacturers Association.
[8] Deoras, P.J. & Vad, N.E., J. Uni. Bombay, 34 : 41. 1961

In the new emphasis on agricultural development and production, the problem of rat control assumes special significance and it is here that the role of snakes needs to be visualised. Technical observation shows that snakes prefer rodents like rats as food.[1] The Russell's vipers brought to Haffkine Institute are often seen vomiting a rat or two. The economic value of rattle-snakes has been visualised in America, because of their destruction of small animals like rabbits, squirrels and gophers.[2] These mammals would otherwise have caused great destruction to agricultural fields and grazing areas. In fact many specialists caution that before any methods of rattle-snake or other snake control are adopted, except where safety to human life is paramount, consideration should be given to the economic aspect to find out whether depredations by rodents on agriculture are not greater than danger from the snakes themselves.[3]

Many people in India by custom avoid killing a snake, particularly a cobra. In many parts of India, one day in the month of August-September, is marked out as a day of worship for the snake, particularly the cobra. This seems to be primarily a thanks-giving day. It is probably out of gratitude for saving the foodgrains and also for the venom which, when incorporated in a medicine called Shuchika Bharan Ras, saved in olden times a patient from a sure death by cholera. The venom probably reduced peristalsis and prevented dehydration of the patient. In fact, in many houses in Kerala a part of the compound is set apart for snake worship where the snake is supposed to come and partake of the offerings. Possibly the idea seems to have originated from the belief that destruction of rodents by snakes prevents damage to property, thus reserving and adding to "Lakshmi" or wealth. Sometimes gardeners ask for snakes for their gardens to keep the rat-population down.

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[1]Technical Reports, Indian Council of Medical Research (1953).
[2]Klauber (1956), *Rattle-snakes.*
[3] Klauber L.M. (1956) Rattle snake.
University of California Press.
Berkley and Los Angeles.

Live snakes and snake skins

A number of institutions in India purchase live snakes for venom extraction, and other studies. For example, Haffkine Institute alone used to purchase about 5,000 snakes per annum. The cost at which the snakes are purchased is Rs. 20 per meter length for a cobra, Rs. 30 per meter length for a Krait and Rs. 1 to 1.50 per *Echis* snake. A 2-meter long python costs anywhere from Rs. 50 to 100 in the market. Government of India permitted the export of 1,00,000 live snakes and an equal number of snake skins per year in 1972. In February 1980, nearly 7.5 million snake skins were awaiting permission to be exported. These are exported to foreign countries for exhibition shows, zoological gardens, and the manufacture of leather good curios.

At some places in foreign countries some showmen make money by exhibiting snakes and showing the method of extraction of venom and charging various amounts of fees. Such shows have come to India also, where people are going in for snake farms for such purposes. In January 1980, a record was established in Pune by living inside a glass cage with 72 poisonous snakes for 72 hours. Such feats would encourage the formation of new shows. In India, a group of people called "snake-charmers" exhibit snakes and solicit money. On *Nag-panchami* day a wholesale market develops for selling cobra snakes to retailers who exhibit the cobra snake for that day. Earning on that day comes to an average of about Rs. 50 per head per snake. At Shirala in Maharashtra the persons who exhibit the cobra snake on *Nag-panchami* day earn on an average Rs. 150 per head.

In the Ahmadnagar district of Maharashtra there are about three hundred families whose main source of livelihood is exhibiting snakes from place to place. Their income comprises offerings to a cobra or money received by displaying other snakes. Similar families reside near Delhi and at many places in southern and eastern India. These professionals earn fairly well in cash, apart from getting foodgrains, clothing, fruits and milk as offerings. However, few people realise that only one poisonous snake, i.e., the cobra, is thus exhibited. Here either the fangs have been pulled out, or they have been plugged. In some cases the poison glands are removed or the

mouth is stitched up so that it cannot bite. Apart from the cobra, most other snakes exhibited are the rat snake, the water snake, python, sand boa, wolf snake, checkered keel-back, striped keel-back and Diadema snake.

The skins are more in demand outside India. The *Times of India*, dated 13-3-1970, wrote in their *Current Topics* that snake-skins earned rupees thirty million in 1967 in foreign exchange to India. Before World War II, reptile skins worth four and half million rupees were exported from India every year.[1] Government of India permitted the export of 1.2 million pieces of snake-skins per year in 1972. Times of India Bombay edition, published on 22nd April 1986 and 21st August 1986 the arrest of persons who were trying to smuggle out of India snake skins worth one lakh and 12 lakh rupees. Snake skin export is now banned and this arrest was done at one port only i.e. Bombay.

In some West European countries the leather products of snake-skins are very popular. They are made into belts, wallets, purses, comb-cases, cigarette cases, tobacco pouches and cufflink heads. Articles of sport and dress like sports jackets, caps, shoes, neckties and even evening gowns have been made out of snake-skins. Sometimes lamp-shades, book-covers, knife covers are also made. At the Instituto Butantan in Sao Paulo, Brazil, a large number of books in the library are bound in snake-skin.

Snakes as food

During the last War, the Chindwin expedition in North Burma survived on python soup. Snakes are eaten as food in China and Burma and in many parts of rural and tribal India, especially the north-eastern region and also by wild tribes in Madhya Pradesh. In Hongkong, snake gall-bladder is used for making wine and other medicinal preparations, apart from being eaten raw, as an aphrodiastic. Japan Snake Institute makes wines out of snake bodies. In the U.S.A. canned garter snakes are on sale as food. Some authorities consider that rattle-snake meat can rank with other flesh for palatability and

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[1]Klauber. (1956), *Rettle snakes.*
University of California Press.
Berkley and Los Angeles

many consider the meat definitely appetising.[1]

A rat-snake normally lays about 70 eggs. These eggs are slightly bigger than the eggs of fowl and they have a softer leathery covering, and have blunt ends. It has been reported that some people in the hinterland in India eat these eggs.

Snake fat

The use of snake fat for medicinal purposes is seen in the Ayurvedic system of medicine. Snake-oil therapy has been practised from ancient times. It was considered a well-established remedy, long before the rattle-snake brought it to the attention of the Europeans and Americans. Viper snake oil[1] was commonly recommended for some medicinal purposes. Later, in Europe, rattle-snake oil was substituted for it and was much favoured.[2] Among the many uses of the oil are "to absorb tumors or swellings", "for relief of frozen limbs," "for bruises, aches and sprains". Some authorities have, however, expressed doubts about the real utility of the oil. Dr Klauber, who doubted some of the supported virtues of the oil tried it as a pain reliever but with no success.

Snake Venom

Antivenin

In india snake venom is in demand primarily for the manufacture of antivenin. This is mainly manufactured at the Haffkine Institute, Bombay and at the Central Research Institute in Kasauli.[3] The Serum Institute near Pune has recently started making a Polyvalent antivenin.

The use of snake venom in relieving pain and certain other muscular disabilities is becoming more common. Experiments are taking place regarding its use in various ways. The injection of cobra venom solution has given relief from pain in a large number of patients who were suffering from neural

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[1] *Ibid.*

[2] *Ibid.*

[3] At present venom costs in India from about Rs. 600 per gram for cobra to Rs. 1000 per gram for krait and echis snake. In the Five Year Plan the requirement of this particular venom for India was stipulated as 465 grams per year.

leprosy.[1] The use of cobra venom is also being more and more recommended in chronic pains of nervous and muscular origin, arthritis and in inoperable malignant diseases. Its solutions have even been recommended in the treatment of epilepsy,[2] and arthritis.[3]

American medical experiments show that cobra venom solution is useful in the case of intractable pain due to cancer, neuritis, arthralgia, neuralgia, migraine and neural leprosy. The consensus of medical opinion appears to be favourable to the therapeutic uses of cobra venom.[4] Toxicity of such preparations is not great and the chief point to be kept in mind is that dosage is determined for each patient separately. The main advantage of cobra venom therapy appears to be that it is not depressing for higher centres of the brain. It can also be substituted gradually for opium in cases of narcotic addiction to that drug.

The venom of Russell's viper can be used as a haemostatic agent on account of its coagulating factor. In cases of haemophilia and haemorrhages from other causes, graded intramuscular injections of this venom solution have been used with encouraging results in haemorrhages from the uterus and the retina.[5] The solution is frequently used by dentists to stop excessive bleeding. It is also used after dilution as an intramuscular dose for the arrest of internal bleeding. It has been included in a standardised dosage against haemophilia.

In homoeopathy, certain diseases like epilepsy, asthma, neuralgia, neuritis, lumbago, sciatica, tics, coccygodynia, laryngitis, pleurisy, debility, nerve exhaustion and insomnia are considered to be curable by the venom of a rattle snake.[6] Even krait venom is sometimes used for this purpose.

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[1]Chopra and Chowhan (1950). They opine that "cobra venom plays a definite role in relieving pain of an indefinite nature in a large number of patients".

[2]*The Journal of American Medical Association*, vol. 115 (1943), p. 1196

[3]*Newsweek*, USA edition, 3 December 1979, Page 89.

[4]*Ibid.* Volume 138 of 1948, page 396. It is recommended here for chronic pain and advanced cases of cancer also.

[5]Pradhan and Patwardhan (1941). Fullerton has recommended the venom of Russell's viper for prothrombin time estimation.

[6]Klauber (1956), p.794.

In the Ayurvedic system of medicine, cobra venom is used in the preparation of certain *Rasas*. *Shuchikabharan Ras* which contains this venom as one of the constituents was used against cholera as well as tuberculosis.

Vishayan matra is administered in Bihar, Orissa and M.P. to patients who have collapsed with heavy fall in temperature and blood-pressure.

Venoms of other snakes are also regarded as of great medicinal value in India though it is the venom of the cobra which is principally used in Ayurveda.

There is a popular belief in the medicinal utility and properties of the flesh as well as skin of certain snakes in most Eastern states of India. The dried and powdered flesh of 'Tamool' (an inoffensive hill snake) and the Malayan 'Pamboo' have been popularly considered in that part as a remedy against leprosy. The exuvia of snakes, powdered and mixed with the oil of *Dalbergia arborea*, when applied outwardly, is considered to be of value in epilepsy. In the Unani system of medicine, the blood of snakes is also used in the treatment of leucoderma. In many parts of North India, a preparation of arsenic and dead cobra is applied externally for leucoderma and syphilitic rashes. The venom of snake mixed in arsenic, opium and musk is sometimes used as a drug by some addicts and many consider it as a tonic. It is also used as an aphrodisiac and also as a prophylactic against some diseases. Popularly, it is also used as a hepatic stimulant in cholera collapse cases.

Enzymes

Venoms are a good source of enzymes. Neurotoxin has been separated from crude cobra venom.[1] This caused the augmentation of the heart-beat in a toad. Neurotoxin also paralyses the respiratiory movements. Haemolysin which had

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Note : In homoeopathy, the venom of the snake Lachesis is indicated in abscesses, carbuncles, erysipaelas, apoplexy, paralysis, meningitis, mental diseases, asthma tuberculosis, syphilis, chorea, flushes, skin diseases and diseases of the teeth. Cobra venom is indicated in diphtheria and cancerous growth.

[1]Sarkar, Maitra and Ghosh (1942).

been isolated from venom produces augmentation or depression in the heartbeats without causing cardiac failure. Cholinesterase isolated from the venom in high concentration slightly stimulates the heart of a toad but has little effect on blood pressure or on respiration in other animals like rabbits.

A number of other enzymes have been isolated from snake venom for important biochemical research. Some of them are hyaluronidase, ribonuclease, ophio-oxidase, phosphodiesterase, nucleotidase and lecithinase. They have already found their way into many research projects. One of the enzymes is sold at Rs. 9000 per gram.

It will be clear that snakes form an important and integral part in the natural structure of things in this world. No doubt there are some poisonous snakes but all snake-bites are not fatal nor are the majority of snakes poisonous. Moreover, there is an exaggerated fear of the snake and its poison. As already indicated, the majority of snakes are non-poisonous but having no means of identifying them, bite by any snake generally so frightens the bitten patient that he is already half dead with fear. The psychological fear of snake-bite can be removed by a teaching method in which poisonous and non-poisonous snakes can be distinctly identified. The author has seen cases where even suspected bites of snakes had produced distressing symptoms. It is possible to get some temporary immunity against snake venoms by frequent injections of standard venom solutions. One Mr. Haast at Miami in USA takes such injections and has survived the bite effects 126 times. His blood when tranfused has saved some snake-bite cases.

Incantations for cure

There is a belief in India that people could be cured of poisonous snake bites by chanting specific lines which are always a traditional secret. Some such lines have been given at the end of this chapter.

However the author has tested the efficacy of some such lines, chanted quietly by mendicants. Two such instances are quoted in the Hindi journal Dharmayug dated the 21st January 1968 and 7th April 1968. Similarly another journal, a daily newspaper Loksatta from Bombay dated the 30th of June

1968 has also covered these incidents at the Haffkine Institute Bombay. In the first case, an erudite expressed his desire to test his incantations and vegetable material to cure a dog bitten by a cobra snake. A live cobra was made to bite a dog weighing 20 kilogram. The party recited the charms and moved round the dog. But as the dog turned its head, he gave the plant extract in milk ad-lib, to the animal. The dog died in 22 minutes, exhibiting typical symptoms of cobra-venom poisoning. In the second case two Brahmins from Bihar came for testing their incantations. Two rabbits were given an injection of a lethal dose of cobra snake venom. One animal was exposed to their chants and the other was kept as control. The latter died in 21 minutes and the one exposed to chants and shaking died in 23 minutes. Not satisfied with the experiments a male sheep weighing 30 kg. was bitten by a cobra in the calf of its legs. The parties threw rice and vermillion on the animal and chanted. The animal died in 31 minutes.

It may be noted here that a majority of the incantations are against cobra snake bite only. This snake has fixed fangs with an upper channel for the flow of venom from the glands. Many a time this snake is either afraid to strike or gives a sub-lethal dose of venom. Such cases will always survive.

Because people are afraid of snakes, they concoct stories, about their capacity for revenge or super-natural. Often these stories are built round cobra snakes. Four such incidents investigated by the author, are all psychological tricks.

Extermination and Cure

If we take an overall view, it will be found that though poisonous snakes are harmful, snakes in general perform many beneficial activities and a proper understanding of these creatures and their venom can be very useful to humanity and may in many ways help compensate the losses caused by the loss of a few human lives by snake-bites. Sometimes people make proposals for extermination of snakes. First of all it is difficult to exterminate by human agency any species except in a very small area. Experiments on birds and certain other insects have shown that sometimes such disturbance of the natural order creates other problems for man. Of course,

snakes, like extinct reptiles, might disappear by a process of evolution. The destruction of forests and expansion of urbanisation have already had the effect of bringing snakes out of their hiding and diminishing their numbers. We must remember that the diminution or disappearance of snakes might lead to a rapid increase of rodents like rats which might become a menace to agriculture and health.

Many normal precautions can be taken to prevent being bitten by snakes. It is first of all desirable for persons going about in areas where snakes possibly abound, to protect their feet properly with shoes. Keeping rats and frogs away from houses also helps in keeping snakes out because rats and frogs attract snakes as they are their natural food. The keeping of peacocks in agricultural areas, the taming of mongoose (*Plate. 1*) wherever possible, attempts at keeping the bigger owls, falcons (*Plate. 3*) and kites in farms would to a great degree help in the reduction of snakes because peacocks attack and eat snakes and mongoose are natural enemies of snakes. So also are birds like falcons and owls. One method of keeping rats away from houses would be to spray dilute carbolic acid around the houses. A concentrated solution of any insecticide or even phenyl kills a snake. Snakes can also be driven out from burrows and holes by smoke. In Rajasthan, it is customary to cut onion pieces and keep them round tents pitched in the desert areas to keep snakes away, though there is no definite evidence of the utility of this practice. It is possible that the pungent smell of onions might have some effect. Free Press Journal, Bombay dated 10.8.1975 has quoted at page 7, that in a village called Shetphal in Sholapur district of Maharashtra state, every house has a cobra snake. There have been no cobra-snake bites, but the rat population in the village is comparatively reduced.

Snake-bite cures

The surest remedy against snake-bite in India is an injection of the polyvalent antivenin made available from the Haffkine Institute. The details about this injection are given in the third chapter.

In the indigenous system of medicine as propounded by

the sage Sushrut, first aid consisted not only of ligating the area and perfusion but also cauterising the wound with a hot iron rod. The same saint has given details about the preparation of medicines called *Mahagad, Ajitagad,* and *Rishabagad.* It is said that the patient used to recover. Unfortunately no authentic records are available where they are prepared and used.

Often the pods of Lei flowers are used to keep snakes away in villages. Similarly, the muscular action of the anal sphincter of a chicken is said to be used to draw poison from the place of bite. In all parts of India a number of charms are murmured to cure cases of snake-bite. None of these when tested in the laboratory have given any positive results.[1] However, a few Mantras in four different languages are given below[2].

Sanskrit

सर्पोंपसर्प भद्रन्ते सर्प दूंरगच्छ महाविष ।
जनमेजयस्य यज्ञान्ते आस्तीकं वचनं स्मर ।।

Sarpop sarp Bhadrante
sarp Duram Gatch Mahavisha
Janmejayasya Yagnante
Aastikam vachanam smara.

Good-will to all snakes
Go far away oh poison
During the sacrifice of Janme jaya
We have remembered the words of Astika.

Hindi

कहे खुदा, सुने मुहम्मद, साफ्न में विष कैसा है ।
नबी मुहम्मद करे पुकार, जहाँ रहे बैठा है ।।
आदम जा लपेटिये, मन माथे ठहरा ।
हकमार बिखयुंचढ़ें, नरगिस करे खुदा ।।

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[1]Snake charms were tried on rabbits at the Haffine Institute. They could not save the animals.

[2]These charms have been very kindly recited in confidence. The reciters mentioned that they are to be perfected on a Naga Panchami day, Lunar or Solar Eclipse, and the reciter has to observe certain restrictions.

Kahe Khuda, Sune Mahammad
Sapan main visha Kaisa hai,
Nabi Muhammad Kare pukar
Jahan Rahe ghar Baitha hai
Adam Ja Lapetiya, Mana Mathe thahra
Hak mar vikh yun chadhe
Nargis kare khuda.

God says and listens Muhammad
How is poison in snakes
Seer Muhammad orders
Wherever it is stay at home.
Oh Adam go and coil, concentrate your mind.
Surely the poison may rise
But God is kind.

Kannada

आस्मालिंगला कुट्टी, शिरगला हरेदु कालिंग ।
राय बहरेदु, एले नागरन होट्ट शीली एकनूर नागरन ।।
कुट्टि हिट्टन माडि गरुड पक्षि निम्न, पादवे गति टुंपटुस्वे ।।

Aasmlingala Kutti, shirgala Haredu Kalinga
Raya Baharedu Ele, Nagran Houtta
Sheeli Eknur Nagaran
Kutti Hittan Madi, Garuda
Pakshi Nimna Padwe Gatim
Tum Patusva.

Marathi

उठ माल्या अंधारी रात, मिनारी रात मेरु भगत अध्याला हाथी गेला,
रिशाशढ़ी साथी भाऊ, बनास गेले, अरे विचवा, होता कोठे वंगनात,
तिथे होता अरे कपुष्ता, गंगाराम ढवले घोड़े.

Uth Malya, Andhari Rat, Minari Rat Meru Bhagat
Adhyala Hathi Gela, Rishashadhi Sathi Bhau, Vanas Gele
Yere Vichawa Hota Kothe Vanganat, Tithe Hota,
Are Kapushta, Gangaram Dhawle Ghode.

It will be noted from the few translations that the words are psychological chants, probably to keep the mind of victim away from the injury. They may act like Placibo injections.

Finally, it is necessary to understand the important role of snakes in our natural and agricultural economy. If we take proper precautions and try to understand the distinction between venomous and non-venomous snakes, it will help us in utilising the majority of the snake population for a useful purpose for which nature has intended them.

CHAPTER II

SNAKES IN INDIAN CULTURE

SNAKES, and particularly cobras, have been intimately associated with Indian folklore, religion and art. There are two days in the year, *Nag Panchami* and *Anant Chaturdashi* (these fall approximately in July and September) when the Naga (cobra) is worshipped in India. (*Plate* 12). The legend of this worship is still not fully known but it is from the most ancient times that this form of worship is prevalent. Of the two days, *Nag Panchami* is the more common throughout the country. There may be variations in the date and the local traditions and modes of observance but it is celebrated in most parts of India according to ancient belief. This testifies to the feelings of awe and veneration which the serpent evokes in the minds of the people from the earliest times.

There is a legend prevalent about how the *Nag Panchami* day for observance of Naga worship started.[1] This Naga story

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[1]Vogel (1926). The full story as related in folklore is given separately here. "Oh God : Nagas, hear. There is a city called Manikpura (or Manipura). In it lived a Govade (Gaur) Brahmin. He was ignorant of *Nag Panchami*. And he did not know that on that day there should be no ploughing, no digging, no plucking, no burning and no roasting. But he went to plough his land on that day as usual. There was a hole of a Nagin (a female cobra) in one place in the field and in it were her young ones who died by a strike from the plough. The Nagin who had gone out returned, and finding that all her young ones were dead, she grew enraged and set out to ascertain who it was that had killed them. Thus she came to the house of the Brahmin and seeing that blood had stuck to his plough, she decided that it was he who had killed her young ones. She, therefore, bit the Brahmin and called on the members of his household who had gone to sleep and killed them. And in order that his whole family might become extinct, she went to bite his daughter who had been married in another village. But the daughter had painted the Nagas and

is repeated at the time of Naga worship. It is difficult to say when this old legend started.

At Shirala in Maharashtra, freshly caught cobra snakes are worshipped in public (*Plate 9*). A procession of villagers carrying mud pots containing cobra snakes proceeds to the Goddess temple. The snakes are taken out by the tail and made to swing their hoods to the swinging of stones in a pot held by another villager. All over India, snake-charmers carry live cobra snakes on *Nag Panchami* day, from door to door, where devout people offer milk, grains, coins, and clothing to the charmers, while worshipping the snakes.

The story is repeated at the time of the festival. Milk and offerings are offered to please the Nagas. Customs differ in different parts of India for worship of Naga. In Bihar, women whitewash their houses and worship Shesh Nag with milk and parched grain. On *Gobar Panche*, which falls on the 5th day of the dark half of the same month, Naga is worshipped in Patna. In South Bhagalpur district it is called *Behra Panche*.

In U.P., according to custom, the head of the family takes a bath, paints on the wall of his bedroom two outlines of serpents and then gives gifts to Brahmins as offerings. People

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having worshipped them and given them offerings, had placed before them at night frank-incense and other fragrant things, lamps, etc. On seeing this, the Nagin enjoyed the good things that had been placed there, and being pleased, said to the girl : "O daughter, thy father killed all my young ones today while ploughing the field. After having killed all the persons in thy maternal home, I had, therefore, come to thee too, but as thou didst remember me and worship me, I am pleased and, therefore, I do not bite thee."

On hearing this, the daughter said : "Thou hast killed all the persons in my maternal home; tell me some remedy by which they may come to life again". Thereupon the Nagin said, "Do thou take this nectar and sprinkle it over their bodies and thereby they will be restored to life". Meanwhile the people in that Brahmin village began to inquire why it was that the Brahmin had not yet arisen and opening his door found that all the persons in the house had died. Just then the daughter arrived and sprinkling upon them the nectar given by the Nagin, resorted them to life. Then she told her father all that had happened and added : "Now from this day, when the month of *Sravana* cometh, thou shouldst worship the Nagas on the fifth day in the bright fortnight according to rites laid down and should place before them at night frank-incense, lamps and food. And on that day thou shalt not dig, neither shalt thou kill anything on that day."

generally pray to the eight Naga chiefs. Girls throw offerings into water. No work is done on that day, artisans and labourers take a holiday and worship the tools which they use. A week before the festival, a mixture of the flour of wheat, gram and pulses is prepared in water. On the morning of the festival day, some grass is tied up in the form of snake, dipped into water in which the corn mixture has been prepared and offered with money and sweets to serpents.

In the eastern districts of U.P., it is customary for girls to let dolls float in a tank or river and the village boys beat the dolls with long sticks. This is explained by a legend which is based on the story of Janamejaya and the Nagas. In Mirzapur district, *Nag Devata* is worshipped by the 'kols' on the occasion of *Nag Panchami* and the date of the fair is the 11th of the brighter half of *Sravana*. In some other parts of U.P., *Nag Panchami* is celebrated in *Bhadrapad* (August-September). In some other districts, it is the 5th of the bright half of *Sravana*. In the district of Garhwal, the ground is cleaned and whitewashed. Figures of serpents are drawn in outline with sandalwood paste or turmeric. Parched rice is prepared and lamps are displayed before these figures. Food and fruits are also offered both in the morning and in the evening. During the night, people listen to stories in praise of the *Naga Devata* (Naga God).

In the Santhal tribes there is a custom to designate a virgin girl as "Visha-Kanya". She carries on her neck a snake venom ampoule and intimidates trouble shooting males to submission for fear of death by venom. In Goa the idol of Goddess Shanta Durga shows a similar young girl holding two cobras in check with upper arms while pressing down figures of God Vishnu and Mahadeo by lower hands.

In Nepal, the festival is held on the 5th day of the dark half of *Sravana* (July). There, the festival is held at *Changu Narain* where it is said that the image of Garuda (divine eagle) perspires regularly on that anniversary. The priest wipes the idol with a handkerchief which is sent to the king. Even a thread of that handkerchief is said to make it into an infallible remedy against snake-bite. A ritual worship is performed at the confluence of two streams. The performer, after taking a bath, offers a dish in which rice, milk, water, rice-flour,

flowers, ghee, spices, sandalwood powder and incense are placed. He prays to the Nag Raja (Naga King) to bless their crops and chants blessing to him also.

In Punjab on the day of *Nag Panchami* a figure is drawn in black on the house-wall. It represents the snake-God in his dwelling place and is believed to prevent the house from being infested with snakes.

Snake Legends

There are many snake legends in the *puranas*, which are popularly known and cited. Some of them are given below. The Goddess Manasa, who is worshipped in connection with the festival is identified as the sister of the legendary serpent-king 'Vasuki'. According to the *Mahabharta*, she was married to the sage Jaratkaru and was the mother of Astika. Legend has it that Astika saved Nagas from being exterminated during the serpent sacrifice performed by Janamejaya. Manasa is believed to afford protection against snake-bite and is called 'vishahari' (poison-remover). She is represented as a beautiful woman of golden colour sitting on a water-lily and covered with snakes.

The legend of Krishna and the Nag 'Kalia' known as *Kalia Mardan* (*Plate* 4) is universally known. Kalia was polluting the water of the river Jumuna with his poison and Lord Krishna, even as a child, jumped into the water to subjugate this formidable Naga-king.

The legend of the churning of the ocean (*Samudra-Manthan*) is well-known in which it is said that the Devas (the gods) and the Asuras (the demons) joined hands to churn the ocean. They used the mountain peak Meru for churning and they utilised the coils of the great serpent Shesh Nag as a churning rope. They are said to have recovered 14 inestimable jewels.

This in short means that Aryans requested the ocean going Naga Kings to bring a ship and this was called *Meru*. Naga king Shesh Nag was made the captain of the ship. He sailed far and wide and brought wealth to India. Alongwith the wealth came undesirable elements that were subdued by God Mahadeva.

King Janamejaya performed the snake sacrifice in which

all snakes were thrown as offerings to fire to take revenge for the death of his father Parikshit at the hands of Takshaka, the snake king.

In South India, termite mounds are especially worshipped since cobra snakes are said to live in them.

The supreme Lord, Vishnu, is always depicted as resting on the many-hooded serpent in an ocean of milk (*Kshir-Sagar*) (*Plate* 5).

Lord Ganesh is shown with a weapon called *Naga-Bana* (snake arrow).

Lord Shiva is popularly depicted wearing a garland of a cobra round his neck. In one of the systems of *Yoga*, known as the Kundalini Yoga, the supreme power Kundalini is shown as a coiled female cobra which gradually ascends the spinal column.

The seal of some of the maharajas of Orissa pictures the crest of a cobra with a human face under its expanded hood and surrounded by the insignia of royalty. The rajas of Chhota Nagpur claim to have derived their origin from the Naga *Pundarika*. A certain section of the Kayastha community in Bengal consider that their origin is from the serpent-king Vasuki.[1 and 2] The seal of the maharaja of Gwalior had the insignia of an entwined cobra.

In Chamba, Kangra and Kashmir temples are dedicated to various Nagas like Shesh Nag, Basak Nag, Takht Nag, Prittam Nag, Sabir Nag, Karkotaka Nag, Karsh Nag, Indru Nag, Santan Nag and many others which are worshipped in human form. Over each human form, however, there is a hood of three snakeheads. In the valley of Chenab, the temples of Vasuki have a Wazir who is probably Jeemut Vahan.

The famous dynasty of the kings of Kashmir in which the famous Lalitaditya was born is considered to be descended

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[1]Vogel (1929, p.17) mentions that "innumerable are the famous lords of Nagas, headed by Vasuki and beginning from Takshaka, earth-bearers resembling the sacrificial fire in their splendour (*tejas*); who increasingly cause thunder, rain and heat and by whom this earth with her oceans, mountains and continents is supported and who in their wrath might smite the whole world by their breath and sight".

[2]*Oldham* (1905).

from the Naga king Karkotaka. Oldham has mentioned that in some of the Himalayan diallects, *kira or kiri* means a serpent. This name is found in the *Rajatarangini*, where it is applied to a people in or near Kashmir. The *kiras* are mentioned by Varaha Mihira and also inscribed on a copper plate. (The name might perhaps have come from *kirata*.)

Coiled serpent images are found all over India. In Saurashtra, every village has a serpent temple (*Sermalia*). In Saurashtra near Dhangadhra, there is a "*Sarmalia*" which consists of a tiled roof room inside which is kept a coiled cobra snake image. During the Nagpanchami celebrations, the Maharajah of Dhangadhra visits this temple and offers his turban to the deity. It is said that a live cobra visits the place and moves into the turban for some time. Naga worship is very common in the South. For example, in Mysore State, people keep images of coiled serpents beneath a Ficus tree. The images are worshipped for getting children, wealth,rain or longevity (*Plate 6*). In Andhra Pradesh the cobra snake worship is done on Nagapanchami day. In Madhya Pradesh too, this festival is observed with great gusto.

In Tamil Nadu, there are many places where snake images are worshipped. In Kerala the famous artist Raja Ravi Varma ruled a small feudatory kingdom from a place called Mavelikura. Near this town one observes even today a small monument called Kawus erected in a corner of the residential houses especially of Nairs. This monument consists of a platform bearing a motif of cobra-snake hoods. The inmates of the house offer food to "Snake Gods". This is supposed to keep wealth intact in the house. The scientific explanation is that rats come to partake the food. The snakes then come after the rats. Rats that damage food-grains in the house are thus killed or destroyed by the snakes; thereby keeping the "wealth" food grains unharmed.

Similarly about 10 miles from this town is a village called Mannarshala which has an old "Snake-God" temple. This temple is about three hundred years old. Situated amidst tall trees and greenery the temple consists of a tiled roof structure with a hooded cobra image devoutly worshiped specially by a revered Amma. There are a large number of hooded cobra images scattered all over the temple premises. (*Plate* 10).

During the afternoon and evening, when the routine worship is being done, apart from other devotees, a large number of patients come here for a cure of their illness, which consists of symptoms like developing patches of falling skin on the face and hands. I have visited this temple in 1983 and have seen the patients. They were suffering from Psorosis. (*Plate* 11).

In the Valley of the Chenab in North India, amongst many families every male member bears the name of Vasuki who was a legendary head of the Nagas. There is a popular legend that Nagas inhabit lakes, pools and springs. We find mention of it in many folk fales even today. On the other hand, we find it rarely mentioned of Nagas inhabiting mountains and trees in any legendary tale.

Snakes in Ancient Literature

There are numerous references to snakes and their characteristics in Sanskrit poetry and ancient literature.[1,2,3]

Prayers are offered in Nagas, either for getting their goodwill or keeping snakes away. In many prayers to gods, the name of Naga is mentioned.[2]

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[1]"A snake drinks air yet is not weak."

(सर्पाः पिबन्ति पवनं नच दुर्बलास्ते)

[2]"Those who will remember the nine Nagas, Ananta, Vasuki, Shesha, Padmanabha, Kambala, Shankhapala, Dhritarashtra, Takshaka and Kalia, particularly in the morning time as well as in the evening, will be free from the fear of venom and be victorious all the time".

(अनन्तं वासुकिं शेषं पद्मनाभं च कंबलम् ।
शंखपालं धृतराष्ट्रं तक्षकं कालियं तथा ।
एतानि नव नामानि, नागानां च महात्मनाम् ।
सायंकाले पठेन्नित्यं, प्रातःकाले विशेषतः ।
तस्यं विषभयं नास्ति सर्वत्र विजयी भवेत् ।)

In the prayer to Lord Vishnu, it is mentioned :

One who has subjugated and
sleeps on a many-headed serpent,
One on whose navel-lotus
the Brahma stays.

शांताकारं भुजगशयनं पद्मनाभं सुरेशं .....

In the prayer to Lord Shiva in *Shivakavacham*, the following line is mentioned:

"Naga in the ear as earrings,
Naga as a garland,
Naga round the head,
Naga round the body,
Thus our lord
Trimbak who has
conquered death, killed
the demon Tripur, cosmic
form and with three eyes."

नागेंद्रकंडल, नागेंद्रहार, नागेंद्रवलय, नागेंद्रचर्मधर
मृत्युंजय, त्र्यंबक, त्रिपुरांतक, विश्वरूप, विरूपाक्ष

In the *Shiva Panchakshar*, there is the mention of the Naga :

"One who has garland of *Nag* snakes, one who has three eyes, one who has put *Bhasma* on his body, one who is a great God, one who is eternal, one who is pure and dons the universe, I bow to that *Nirguna* Shiva."

नागेंद्रहाराय त्रिलोचनाय,
भस्मांगरागाय, महेश्वराय,
नित्याय, शुद्धाय, दिगंबराय,
तस्मै नकाराय नमः शिवाय ।।

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[3]"One who remembers Karkotaka Naga, Nala and Damayanti, King Rituparna and sings their praise will be absolved of the consequences of Kaliyuga age".

(कर्कोटकस्य नागस्य दमयंत्या नलस्य च ।
ऋतुपर्णस्य राजर्षेः कीर्तनं कलिनाशनम् ।)

In the Shivashtakam, it is mentioned :

"One who has a garland of skulls, one who has snakes all over the body, one who is the Lord of Death and one who is the guardian of Lord Ganesh."

गले रुंडमालं, तनौ सर्पजालम्,
महाकालकालं, गणेशाधिपालम् ।।

In the *Devistotram* it is mentioned :

"One who has smeared the *Bhasma* (ash) of a funeral pyre, one who has digested the famous poison, one who is clad in cosmòs, one who has long tresses of hair, one who has a fiery snake on his neck and is the Lord of a bull."

चिताभस्मालेपो, गरलमशनं दिक्पटधरो ।
जटाधारी कंठे भुजगपतिहारी पशुपतिः ।।

In Vedic literature, there is frequent mention of snakes. In the *Rig Veda, Ahi* means a snake, and Indra, Chief of the Devas, defeated *Ahi* Vritrasura.

In the Yajurveda and the Atharwaveda, the following reference is found :

"Homage to the snakes which move ever around the earth, which are in the sky and in heaven, to those snakes which are in the arrows of sorcerers and of tree spirits and which lie in hòles, homage to those snakes which are in the brightness of heaven, which are in the sun, which have made their abode in the waters."[1]

In the Atharwaveda, which abounds in magic spells, there are numerous references to the charms which are used to avert damage or injury by snakes. In the *Ramayana,* it is narrated that the Naga mother Surasa appèars in the guise of a Rakshasi in order to test the strength of Hanuman during his flight to Lanka. In the last canto, it is mentioned that Seeta, who was swallowed by mother earth, was carried on

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[1]Oldham(1905)

the lap of Goddess Earth who is seated on a throne which is carried on the heads of Nagas of boundless light.

In the *Mahabharata*, it is mentioned that Baldev, elder brother of Krishna, was an incarnation of Shesha Naga. There is also the legend of Arjuna marrying Ulupi, the snake nymph and the marriage of Rishi Jarat Karu with the sister of the snake-king Vasuki.

In the *Mahavansha*, it is mentioned that Sanghamitra, daughter of the Emperor Ashoka, took the form of Garuda to vanquish the magic powers of the Nagas who wanted to take away the branch of the Bodhi tree which she was carrying to Ceylon.

In Buddhism, there is frequent mention of snake worship. At many places, Lord Buddha is shown under the shade of the expanded hood of a seven-headed Naga. So also in Jainism, the tirthankars are depicted sitting in meditation with a seven-headed cobra hood on their heads.

In the Puranas, the legend is that the favourite haunt of the Nagas is Patala (hell). Among the various attractions of the serpent world, the Naga kanya or snake-maiden is not the least seductive. It is considered that these snake maidens have the quality of arousing the passions of men and thus seducing them.

In Sanskrit classics, there is frequent mention of the Nagas and their powers. In Kalidasa's *Raghuvamsa* in the 16th canto, it is related that when the king lost the magical amulet given to him by Rishi Agastya, it was supposed to have been taken away by the Naga Kumuda, who lived in a pool of the river. The king shot the powerful Garuda weapon and immediately the Naga King came out with his youngest sister, the beautiful Kumudvati, who playfully had taken the amulet. The Naga King restored the jewels and offered his sister in marriage to the king.

Snakes in Indian Art

In the cave paintings of Ajanta, Naga kings have been depicted with an odd headed Naga (Cobra). In cave No. 19 Ajanta, the Naga king is seen with a seven-headed hood and attended by his consort. (*Plate 7*)

In many Indian temples, the presiding God has an umbrella

shade of an odd headed Naga hood.

The central arch of the eastern *torana* of the Sanchi Stupa has a well-known relief representing the worship of the Bodhi tree by the animals of the forest. Amongst them there is a five-headed Naga side by side with Garuda (eagle). On the same gateway, we have another scene of the Buddha subduing the venomous dragon in the hut of the Kashyap brothers. Here too the cobra has a five-headed hood.

There are two more reliefs which probably represent Nagaraja, worshipping the Buddha. In each case the Nagaraja is attended by the nagins, all of whom have a single-hooded snake at the back of their head, while the Nagaraja has a five-headed hood. The single headed snake hood is specially noticeable in the relief on the western gate (*Plate 8*). It has the look of a cap or covering. It is not clear whether they mean to be taken in for a head-dress. The use of the cobra hood for different purposes is a significant development as indicated by art structures at Sanchi. The five-hooded snake is shown as being subdued in one place and in another relief with other animals. On the *torana* on the left of the main entrannce, the Nagaraja has the five-headed hood over his head. Plate 13 This is noticeable also in another small relief. Though it is difficult to interpret definitely, there is a possibility that the use of the hood in this way might have become a royal insignia to be used over the head of a king.

In another Stupa at Sanchi, a complete circle indicating the sun is shown in which a coiled hooded cobra is depicted. This is on the south-eastern *torana* of the Stupa. On the north-western side of the Stupa, there is again a hooded snake inside a round disc. Here two Nagins are holding garlands to the Naga. This five-hooded snake shows a bifurcated tongue (*Plate 14*). In Sanchi, there is also a life-size statue of a Naga king with not only a snake hood but the snake coils running down his legs.

These reliefs indicate some relationship between the sun, the many-headed cobra and the use of many headed hood as a symbol of honour. Some scholars consider that the cobra

hood is a totem of sun worship and all those who trace their geneology from the sun could use it over their heads.[1]

Snakes in Other Countries

Snake and sun worship was not confined to India alone. The Greeks worshipped the sun and the serpent from the earliest times. They were also worshipped by the Phoenicians and the Babylonians. Traces of serpent worship were found in Syria and other parts of Asia even at the beginning of the Christian era.[2]

In Egypt, the sun was worshipped and the hooded serpent (Ureus) was held sacred from the earliest times. A symbol of the hooded serpent was attached to the front of the king's head-gear. This was not merely a badge of royalty, but was also a protection for the king. Negus, the title of the King of Abyssinia, might be closely related to that of Nagi, which is used by chiefs of the Khus tribes of the Himalayas who worship serpents. In China and its neighbouring countries, the worship of the sun and the serpent was known from ancient times. The Dragon (or Naga) still protects the empire. Shrines of Ling Wang, the Dragon King (Naga Raja) are numerous.

In Korea, people feed and worship serpents, as the guardian genii of their household. In Japan, the ritual connected with the worship of the sun and the serpent was in all particulars nearly the same as in India. In Tibet, the springs, rivers and lakes are still ruled by the Naga demi-gods. According to their belief, Lu-Naga King lived in a crystal palace in the depth of lake Patli.

In Central and Western Africa, the serpent and the tortoise, designated as the totems of the solar race, were held sacred. No important venture was undertaken without a sacrifice to the serpent. When the Spanish invaded South America, they found that snake and sun worship was universal there, with the exception that the place of the hooded serpent (Naga) was

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[1]Oldham (1909).
[2]*Ibid*.

taken by the native rattlesnakes (because the hooded serpent does not exist in America). The attributes of the rattlesnake were the same as those given to the Naga in India in its legendary lore.

The universal worship of the snake, particularly the Naga, has been the object of study by many modern scholars. Deane Oldham and Dr. Bosch have carefully analysed and given their interpretation of Naga worship.[1]

In view of the ancient customs and beliefs quoted above and the views of the authorities that have been quoted, Naga worship and its importance in art and culture are highly

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[1]Rev. Deane (1833) says "the deception of Eve by Satan, through the instrumentality of a serpent, has been an object of ridicule with the profane. Snake worship is as old as sun worship. If the worship of the sun, therefore, was the first deviation from truth, the worship of the serpent was one of the first innovations of idolatry. The serpent was the most ancient of the heathen gods."

Oldham (1905) has summarised his conclusions thus :

"We have seen that the worship of the sun and serpent was in time past well nigh universal, and that it was already established among some of the most enlightened peoples of antiquity, at the earliest period of which any history has come down to us.

"We have also seen that the hooded serpent was held sacred as a totem for the people who claimed descent from the sun-god and thus came to be worshipped as a deity. The deification of some sun-worshipping countries arose from the corruption of the earlier worship of a supreme deity who was supposed to reside in the sun. The Gayatri, the most sacred text of the Vedas which contains the essence of Hindu religion, is a short prayer to the sun-god, who is addressed as Savitri–the generator or creator.

"The combined worship of the sun and the serpent-god must have spread from a common centre by the migration of or communication with the people who claimed a solar descent. So universally was the Naga held sacred that it would seem to have been the earliest totem of the people who claimed descent from the sun-god. The Naga of Indian mythology and folk-lore is not really the snake in general, but the cobra raised to the rank of a divine being.."

"Divine serpents are many-headed. It is a characteristic of the Nagas often insisted upon in literature. In art the number of heads varies: but is always uneven: it may be three, five or seven. It can be a matter of surprise that a marked preference for the number exists. In literature too, the five-headed serpent is often mentioned; as simile in the epics likens it to the human arm ending in the hand with its five fingers."

Dr. Bosch (1960) has another interpretation. He says :

"The human arm frequently occurs as a symbol of the lotus-stalk. We shall refer to this again and as the Naga fulfils the same part it follows, in accordance with the rule of identification through a concealed third that the

significant. I have personally observed the stupas at Sanchi and there is a strong possibility that the cobra snake might be a totem of sun worship and the interpretation given by Dr. Bosch might have some meaning, that the five headed Naga is a hand raised with fingers as in benediction. However, the matter requires to be more carefully considered and investigated.

In ancient times in India, kings were *chhatrapatis* (royal persons entitled to a *chhatra*, that is, an umbrella, as insignia). The Naga hood appearing over a king might be a totem or symbol of sun worship or just royal insignia.

In studying the images, we find them with many headed snake hoods with human form or with a polycephalous snake hood. In literature, one sometimes finds mention of the snake with a thousand heads. Such variations only indicate an exaggeration of this symbol or totem.

The Chinese pilgrim Hiuen Tsiang relates the story of King Udayana who married a Naga princess. According to him, every time he was with her, a single-headed hood of Naga came fourth from her head.[1]

All serpents as such are not so much venerated as the hooded Naga (cobra). In the Udyoga Parva of the *Mahabarata*, it is mentioned that there was a Naga Raja named Asura.[2] In the *Vishnu Purana*, it is mentioned that one of the names of the royal family of the solar race of Ayodhya was a king named *Ahi* raja. Indian folklore is full of legends relating to the rajas and warriors of the serpent race and it is possible that the Indian festival of *Nag Panchami* is celebrated probably in honour of the Naga raja (King). This clarification is exemplified in a very lucid way at verses 28 and 29 in the 10th canto of Shrimad Bhagwadgita. Here Lord Krishna says that the best amongst the cobra snakes is Vasuki (verse 29), and the best amonst the nagas is *Ananta*.

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arm is identified with the serpent's body and that also the spread out fingers are identified with the hood of Naga heads. This explains why in literature the Naga is so often compared and identified with the five-fingered human hand and why, inversely, the Naga head in art not infrequently shows a remarkable resemblance to the human hand with fingers turned in like claws. The number of Naga heads being five may be traced to the same identification with the fingers of the hands."

[1]Oldham (1909).

[2]*Ibid*

It is interesting that the Naga temples in North India are not dedicated to the serpent cobra but to the Naga Raja, the ancient rulers of the race in India. All the Nagas like Shesh Nag, Karkotak Nag, etc., are worshipped in human form with three hoods like a trident. It is possible that the Naga Kings were clever builders and built big cities. The Mayasabha in the Mahabharata might be due to such great architects. According to legend, the Naga kings founded cities like Patal, Pragjyotisha, Takshila, Magadha, Mathura, Vilaspur, etc.[1]

Snakes in India, particularly the cobra, as will be evident from the mythological and historical references that we have cited, are an important symbol in religion, folklore and culture throughout the country. Those who came from the far north and from outside absorbed and accepted it as a part of their culture. A unity of culture thus seems to have been maintained through the ages. Research on this absorbing topic will engage the attention of historians and scholars for years to come to show that the cobra is a symbol of Indian unity of culture and civilisation through the ages.

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[1]Y. Krishnan (1967). *The Naga Cult in Indian Art and Literature.* Reprinted from Oriental Art, Vol XIII (3) 1967, Laurence Press, London.
"Mr. Krishnan observes that nagas are water-gods-the subterranean counterpart of celestial gods-the *devas*. For obvious reasons they are associated with watery places-lakes, ponds, rivers,... As gems, precious metals and minerals are found in the bosom of the earth, the nagas came to be regarded as the guardians of treasurers. Their serpent *Chinha* or mark inspired fear and awe among humans towards them and has caused them to be confused-with terrestrial serpents. No wonder, therefore, that the nagas came to loom large in popular Indian imagination and their cult has wide, deep and ancient roots. This alone accounts for the worship of nagas in Himalayan regions, where poisonous reptiles do not exist."

CHAPTER III

KNOWING THE SNAKES

REPTILES have been on this earth before the mammals were born. They predominated in the Mesozoic period, about 240 million years ago. There were fifteen orders of reptiles at that time and now only five survive. These are :

Order 1 : *Crocodalia* –Crocodiles, Alligators and Gavials
Order 2 : *Chelonia* –Tortoises, Turtles and Terrapins
Order 3 : *Lacertalia* –Lizards, Gekos and Monitors
Order 4 : *Ophidia* –Serpents
Order 5 : *Rhynchocephalia* –Tuatara

Ophidia

Characteristics of Snakes

They have got an elongate body divided into head, body and a tail region. There are no external appendages, except for a few rudimentary bones found internally in Typhlops sp (*Plate 16b*) and externally in *Python molurus* (*Plate 16a*). The body is covered by scales which are imbricate in primitive snakes and form a distinctive covering in other snakes. Special scales developed on the head are characteristics for identifying different snakes. A skin or exuvia is formed on the scales periodically and sloughed off by the snake periodically. The snake grows all along its life. There are 200-300 vertebrae in the snakes and except for the first two and the tail, all vertebrae have ribs. In the tail region the ribs have been fused to the vertebrae.

They have eyes with a round or vertical pupil but no eyelids. There is no external ear, and the three bones of the

internal ear have been reduced to one only. This bone in some snakes is ankolysed to the quadrate. The lower jaw is in two pieces and these are attached in front by an elastic ligament, giving the two parts an ability to move independently. It is not properly articulated with the upper jaw. The tongue is soft and bifid. It quivers in and out through the incomplete joint of the lower jaw. There are solid curved pointed teeth on one or both the jaws, but in some snakes there are additional groved or hollow teeth situated on the pre-maxilla. Snakes do not have the mechanism to control body temperature, and depend upon environmental factors like the sun and humidity to regulate it. Much of snake behaviour, therefore, depends upon his requirement of this regulation, water, food, shelter and reproductive needs. The lungs are rarely bilateral in size and often in higher forms they are reduced or absent on one side. The external opening of the digestive system is in a cloaca, which also receives the openings of the ureter and the genital organs. There are distinctive sex characteristics and the penis in the males is double, being lodged in the tail. After mating at the end of spring some snakes lay eggs. Viperine snakes produce live young ones. The eggs have a leathery covering and contain a huge amount of yolk. There is some maternal instinct as the mother lies curled on the bunches of eggs for some time. Cannibalism is common and young vipers have often been swallowed. Normally the food of snakes consists of insects, frogs, birds, small mammals and in the case of a king cobra, it is primarily other snakes.

All snakes hibernate for some months when the temperatures are not congenial. Their metabolism then is very low, and they survive on the fat stored in the body.

The python is the longest snake and also the heaviest. It has been recorded to grow upto 25 feet and weighs as much as 300 lbs. The smallest ones are about five inches among the blind snakes. Snakes live long. The records in the laboratory show their life as 4-6 years. In nature they live more than 25 years. There is great variety of colouring in snakes. In plain colour we get the deep brown or black cobra or sand boa, *Eryx johnii* and on the other hand we get the white-albino cobra. Parrot green whip snake (*Plate. VIII* col) or green pit viper *Trimeresurus gramineus*, reddish pit vipers

in the Himalayan region, chrome yellow cobra before rains and yellow and blue stripes or marks in a banded krait or *Rhinops* sp. Patterns of colours in yellow and black spots in *Ptyas mucosuos* the rat snake, olive green with yellow stripes in a King Cobra and the same background with checkered black spots in the water snake *Natrix piscator*, are an indication of the variety of colouration that is met with in snakes. In between these, stripes and dots of different colours are also there with iridescence and markings that have various shapes. The markings could be noted in *Echis carinatus* which has an arrow on its head or a python which has between its eyes a javelin-shaped mark. These colourations are in tune with the ecological conditions, for example, Russell's viper which lives in the woods has rows of dark brown spots on a brown background which makes it invisible until it makes the hissing sound.

Limbs

The animals in this group are elongate and devoid of any limbs. In primitive blind snakes there are vestiges of a pelvic girdle. Boidae, the python, has two horny spurs near the anal opening which are capable of a vigorous movement and could inflict serious scratching injuries (*Plate 16 a*). These are vestiges of limbs. In the horned viper *Pseudocerestes persicus* there are small horn-like projections on the head (*Plate 17*).

Skin and Scales

The body is covered by scales made of Kerotin. The scaly covering is overlaid with a thin skin that is cast off regularly. Before this casting off, the colour of the snake becomes whitish, like a bubble filled with smoke. An oily secretion is released between scales and skin, while the skin is cast off like a coat taken off inside out. During the period when the snake is on skin, it is sluggish and due to the opaqueness on the eye, the animal cannot see far. It has been noticed that if the snake cannot cast away the skin regularly at the usual intervals, the animal becomes ill. It has also been noticed that if due to some cause the skin is not cast off completely, it again feels very ill with partly attached skin sticking to the body. At the Haffkine Institute the periodicity of the casting off of the skin

in snake has been observed. The periodicity differs according to the season and age of the snake. It is more frequent in the summer months and less during the colder season. It ranges from 72 to 210 days. In a newly born Russell's viper, the first casting was within 2 days, the second after 7 days and the third after 21 days. Thereafter it went on casting its skin at varying intervals. This is also true of young cobras bred in that laboratory.

The scales on the head are called shields. The classification of snakes is based on the size and disposition of the various head shields in different snakes. In some snakes the scales are keeled. *Echis carinatus* or Phoorsa, rubs these keeled scales to produce a noise when disturbed (*Plate 18*). The broad ventral scales are useful to the snake in taking a grip during locomotion. A land snake cannot move easily in water or on a very smooth surface. A sea snake finds it difficult to move on land.

Hairs

The scales form the only external covering of snakes. It is a common belief in Indian villages that old snakes have white hairs. This is not true. We have seen a cobra in which horse hair had been planted to create a false impression of this type to earn money from credulous villagers (*Plate 19*).

Jaws

The two halves of the lower jaw are united by an elastic ligament and are movable independently. Further, the lower jaw is not properly articulated with the upper jaw. These structural changes therefore permit the python to extend the jaw even upto an angle of 180°, which enables the snake to squeeze in a prey which looks rather big for its mouth. The bifid tongue normally sticks out of the region where the lower jaw has not been articulated properly.

Teeth

There are curved pointed teeth on both the jaws (*Fig. 1*). These pointed teeth may be of various sizes and in python they are lancet shaped. These inflict a very severe injury in

a bite. The recurved teeth hold a prey from escaping and help the propulsion of food into the mouth. In primitive snakes like *Typhlops* the jaws are almost toothless except for a few teeth on the transverse edges of the maxillary bones, corresponding to the palatine bones. In poisonous snakes, the upper marginal teeth on the maxilla do not exist. These snakes have developed special curved teeth which are canalised like a hypodermic syringe needle in some and are movable as in the case of Russell's viper. These teeth in Russell's viper are about 1 cm in length. The teeth being too big lie tucked up by the side of the jaw when in repose. At the base of these canalised teeth opens the duct of the poison glands. These modified teeth are thus movable and also have sheath in Russell's viper. In the case of a cobra, they are 1/2 cm without a sheath and are not movable. In cobra and krait the fangs are not canalised but grooved dorsally. These modified teeth are called fangs.

Fangs

The fangs of the poisonous snakes are present on the premaxilla and not on the mandibles. At the base of the fangs are buds of newer fangs. When a fang is broken, its place is taken by a new one developed out of the buds. The new fangs emerge in three to six weeks. It should therefore be borne in mind that a fangless snake may soon develop them and inject the venom. Moreover a snake which has bitten once is quite capable of biting again with fatal effect. At the base of the fangs open the ducts of the poison gland which are modified parotid salivary glands.

The fangs (*Fig. 1*) in the poisonous snake may be situated in the front regions, as in a cobra or viper or they may lie slightly behind, as in a number of sea snakes. These latter snakes are quite poisonous, but they cannot get a full grip and inject the poison, because the fangs are situated far back on the jaw on the maxilla. That is why there are comparatively few deaths from their bites.

The fangs may have a gutter at the upper side. The incurved sides of this gutter form a channel. This is seen in cobras where the fangs are not movable (*Fig. 2*). They may be completely hollow with a tiny opening at the pointed end, like the injection needle, as seen in a Russell's viper. Here

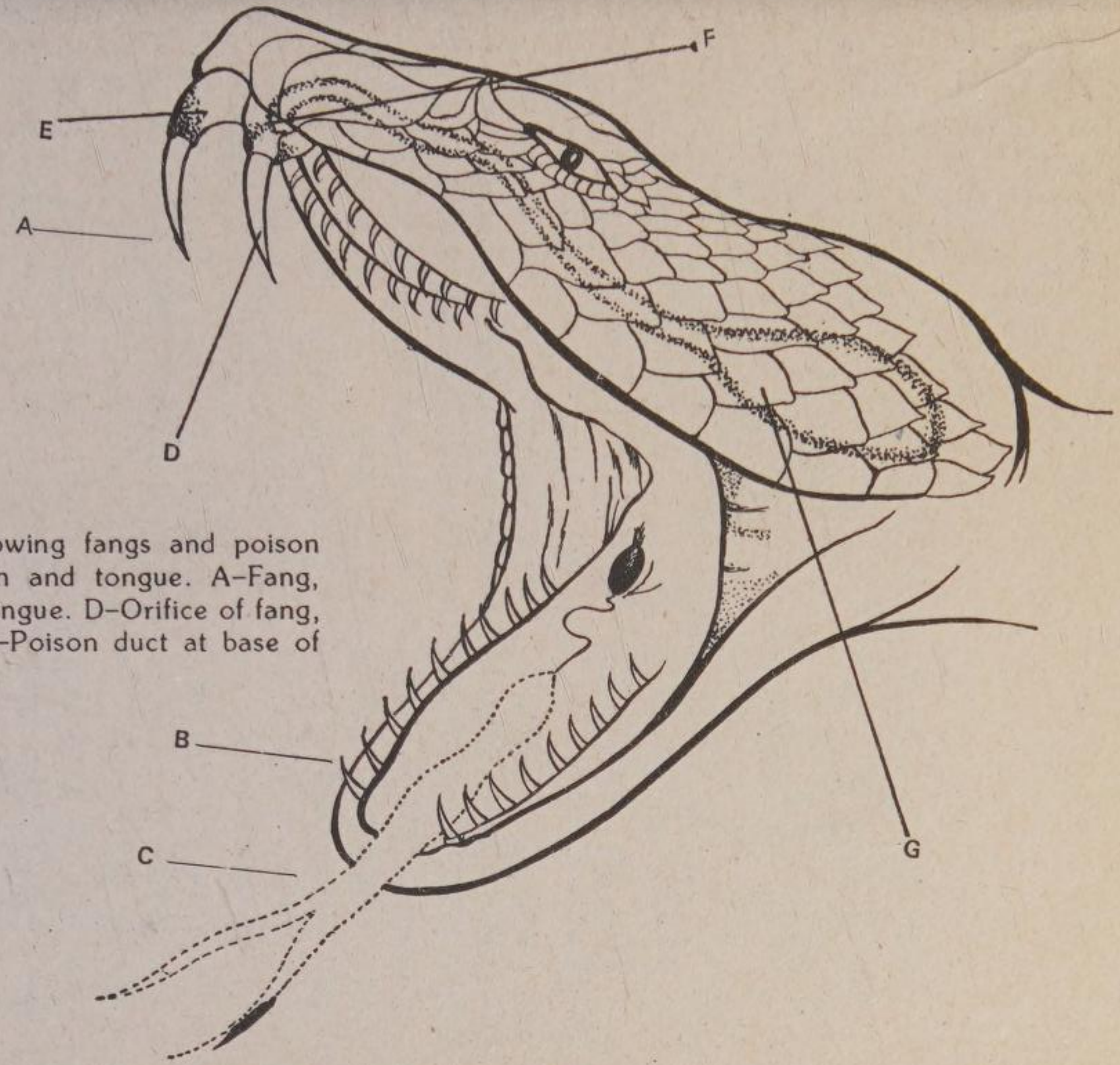
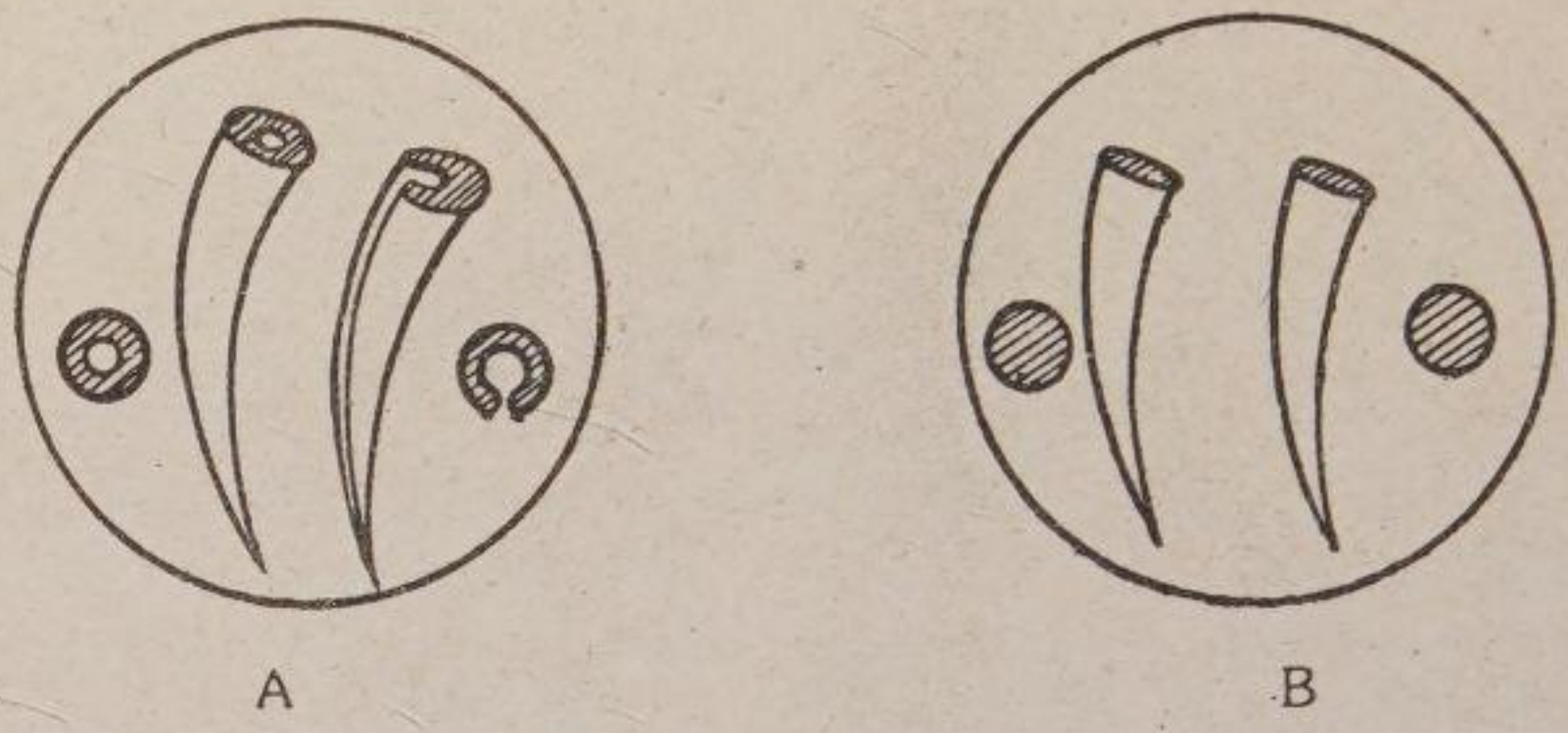
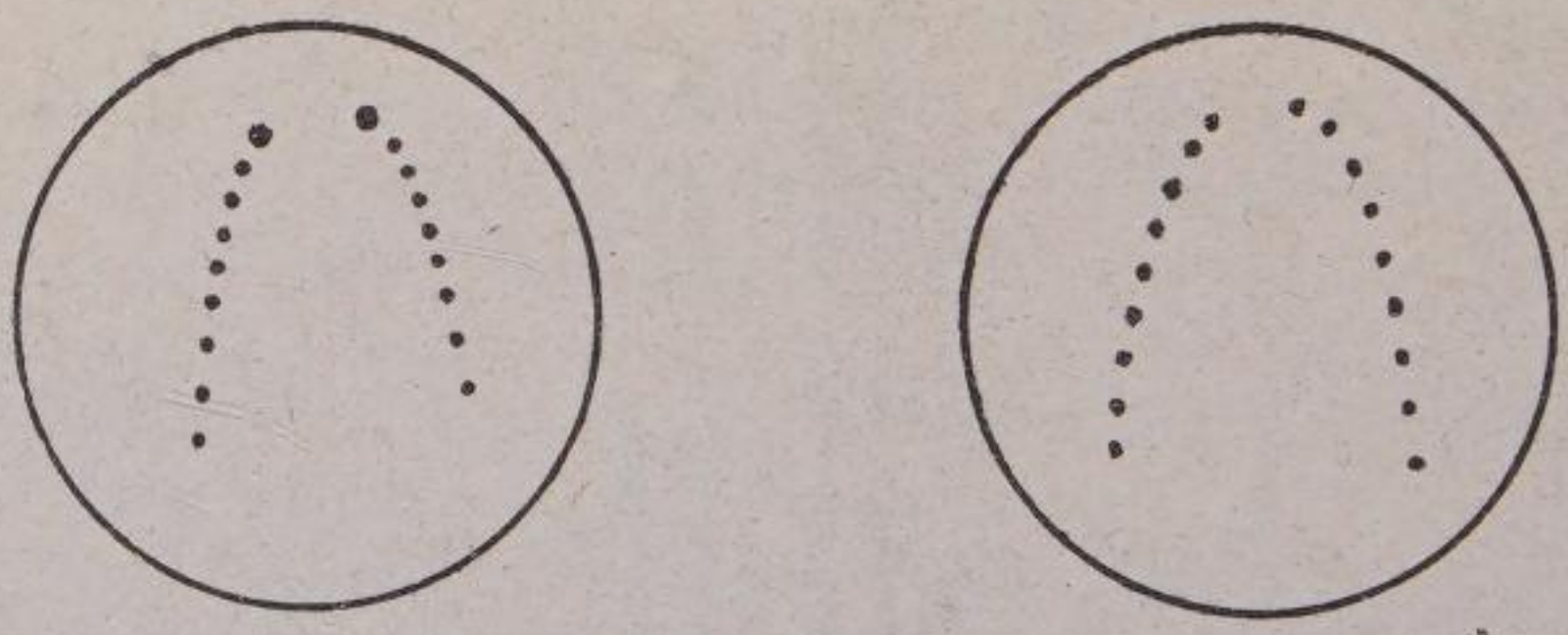


Fig 1 A viper snake jaw showing fangs and poison gland, as well as teeth and tongue. A–Fang, B–Curved Teeth, C– Tongue. D–Orifice of fang, E–Sheath over fang, F–Poison duct at base of fang, G–Poison gland.



A B

Fig 2 "Fangs" of snakes.
A– Canalised teeth of Russell's viper along with gutter teeth of cobra.
B–Solid teeth from lower jaws.



A B

Fig 3 A – Diagrammatic representation of the marks left by the bite of a poisonous snake. Note the two big first round marks.
B – The marks supposed to be left after the bite by a non-poisonous snake. Note the absence of first two big marks and uniform tiny fine punctures.

they are covered by a sheath and lie in repose at the side of the jaws.

Marks

All the poisonous snakes have two fangs. These are curved teeth situated on the maxillary bones. They are bigger than the other teeth and are grooved or canalised as mentioned above. When a poisonous snake bites, it normally leaves two deep fang impressions slightly separated from each other, apart from small marks of the other teeth (*Fig. 3 A*). When a non-poisonous snake bites, it leaves a number of small impressions in a row (*Fig. 3 B*). Many a time the marks may not be so regular. The snake may not have been able to take a proper bite. In such cases which are quite common, there may be a few marks or even a small laceration which may occur when the snake has struck in a hurry.

It is not always that a snake which has bitten may have injected venom. It is also not always that a poisonous snake that has bitten has been able to give a lethal dose of venom. In both these cases the patient may survive without any treatment. Further, a snake can give a lethal dose of venom immediately after one bite. It is also seen that a snake whose fangs have been removed is able to chew sufficient amount of the lethal dose of venom without the fangs. This was noted by me in the case of a King Cobra (whose fangs had been removed) who caught, bit and infiltered venom in the wound of a rat snake before swallowing it.

Mechanism of Attack

The skull bones of *Echis carinatus* are shown in *Fig. 4*. In this figure, the location of the quadrate bone and the pterygoid as levers is to be carefully noted. These bones along with the squamosal play a vital role in manipulating the other skull bones to open the mouth and help the fangs during the mechanism of attack.

Russell's viper prepares to bite by raising its head a little above the rest of the body. The neck and the upper end of the trunk are not shaped into a complete circle, but lie in two or three abrupt curves across the mass of the coiled body.

Fig 4 Lateral view of the skull of *Echis carinatus*.

A–Parietal bone
B–Squaamosal bone
C–Quadrate bone
D–Foramen magnum
E–Collumella auris
F–Occipital condyle
G–Basi-occipital spine
H–Angular bone
I–Forntal bone
J–Nasal bone
K–Lacrymal bone
L–Inter-orbital setum
M–Premaxilla
N–Palatine bone
O–Transpalatine bone
P–Pterygoid bone
Q–Fangs
R–Dentry bone with soild teeth.

The next phase is the forward thrust of the body, which is effected by a sudden contraction of the muscles which lie upon the convexity of the bendings formed by the upper part of the snake, so as to straighten the body abruptly and thrust it in a direct line. The projectile range does not exceed a third of its length.

The forward thrust of the body and the opening of the mouth are accompanied by the contraction of the sphenopterygoids which through their articulation with the maxilla bring the fangs to an erect position. When the eract fangs penetrate the flesh, the contraction of the sphenopterygoids is relaxed and is immediately succeeded by a contraction of the pterygoid externus and palatine (*Fig. 4*). This draws the point of fangs violently backwards, so as to drive it deep into the wound. The lower jaw is closed upon the bitten parts. This is effected by three muscles, the posterior, the middle and the anterior temporal. The last muscle is so folded about the poison gland that while it draws the lower jaw, it simultaneously compresses two-thirds of the body of the gland. The anterior portion of the gland and the duct are also subjected to this pressure. The whole process consisting of the deepening of the wound, holding the prey and ejection of the venom is done in an instant.

There is no truth in the saying that a snake turns round to deposit the venom. Disentangling is done by relaxing the muscles of the neck, so as to leave the head passive, while the continued traction of the muscles of the body pulls upon it and withdraws the fangs.

Snake-venom:Constituents, Symptoms and Treatment

In the majority of venomous snakes, the poison gland occupies a space behind the eye and stretches backwards in length according to the size of the gland. The anatomical position corresponds to that of the parotid glands of the mammals with which its similarity is still further strengthened by the serrous character of the secretion. The venom gland, like the parotid gland, has only one excretory duct. The secretion paralyses the prey and starts disintegration and digestion of the tissues.

Venom Secretion

A snake can bite and continue to secrete the venom a number of times in succession. In Bombay at the Haffkine Institute, snakes were milked for venom once a month and the average yield per snake per time was as follows.[1]

Cobra	0.2 gm	of the dry weight of Lyophilised venom
Russell's viper	0.15	-do-
Krait	0.022	-do-
Echis	0.0046	-do-

The maximum lethal dose of these venoms for an average sized man is :

Cobra	12 mgm
Russell's viper	15 mgm
Krait	6 mgm
Echis	8 mgm

It has been noted by Deoras and Mhashalkar[2] that non-poisonous snakes do have in their blood sera certain inhibitors which protect them to some degree against the venom of some poisonous snakes. I have noted the case of a worker in Florida who used to take a gradual dose of cobra venom whereby he could withstand some doses of pure cobra venom. He has been bitten 123 times by a variety of snakes and is still alive. In fact, the serum of this person saved the life of a victim bitten by a coral snake. It is thus possible to get immunity against snake poison by injection of gradual doses, but this immunity may not last long and secondly, such immunised person may die if the dose of venom received later happens to be higher than the amount for which he is immunised.

Cobra venom is extracted at the Haffkine Institute by allowing the snakes to bite a plastic cloth stretched tightly over a wine glass (*Plate 20*). Russell's viper venom is collected by allowing the snake fangs to press inside the uncovered glass (*Plate 21*). Slightly more of krait venom has been obtained by creating a vacuum in the collecting glass.[3]

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[1]Deoras (1959), (1961).
[2]Deoras and Mhashalkar (1963).
[3]Deoras and Vad (1972).

The poison of a cobra is faint transparent yellow and is slightly viscous. Fresh venom contains mucus along with enzymes and other secretions. When exposed to the sun, it becomes slightly turbid. The viscosity of the venom varies according to season. It is thicker during winter months. Russell's viper venom is sometimes white and sometimes yellow. In fact, during differential milking, the right fang gave one colour and the left another. The toxicity and the frequency of the constituents were seen to be different. We have seen that the venom given by cobra and krait snakes in the open snake farm when dried is higher in weight than that of a Russell's viper.[1] Secondly, the male of cobra and krait gave more venom than the female. It is not so rigid in a Russell's viper. Thirdly, the volume of venom secreted by a Russell's viper is more than that of a cobra of the same size, but the dry weight of this volume is less than the dry weight of cobra venom. It is probably this reason which explains the fact of swellings seen after the bite of a Russell's viper, wherein more liquid has been injected into the tissues. Fourthly, it is noted that there is a variation in the output of venom during different seasons. During the summer months the output is more and probably the lethal dose of this venom is higher. In winter the venom is viscous and comes out in small quantities. This latter venom probably has a lower lethal dose. These factors may explain the higher mortality rate by snake bites in summer months including the monsoons. A black cobra has been seen to give more venom than a brown one, so also a King Cobra gives more venom than the ordinary one. These factors may account for the belief that these black and King Cobras are more poisonous.

The snake has venom from the very first day of its life. It can bite but the amount of venom given may not be in sufficient quantities. After a certain age, there is not much difference in the output of venom in snakes of the same species and this has been noticed in a cobra.

The venom is acidic to litmus paper and has a specific gravity ranging from 1.030 to 1.070. On drying, it settles

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[1]Deoras (1961).

down to fine needle like crystals which will readily dissolve in water and this solubility is retained for a long time. The venom can be handled with safety provided it does not come in contact with blood or the mucous membrane. It could be taken orally provided there is no cut from mouth to the anus. The patient may escape with some symptoms if there is no cut and the venom has not come in contact with blood. In fact we have seen people taking oil in the mouth first, and then trying to suck out the so called poison from bitten parts. This is highly dangerous and should always be discouraged.

Constituents

Venom in general consists of a mixture of many individual proteins that constitute the predominant part of the dry weight of the liquid. It has in it some metallic ions and a number of enzymes too, which are hydrolytic. The toxicity of the venom is not due to any particular constituent but the fact that they act simultaneously and enhance either directly or indirectly the toxicity of the venom.

The pH of a cobra venom is 6.6 and that of Russell's viper being 5.8. The venoms could be dried as crystals or lyphilised. If stored properly in cold they keep their potency for a long time. The dried venoms are easily soluble in water, and the solubility increases in physiological saline.

Kellaway[1] and Porges[2] attributed the toxic actions of venoms to *Proteolytic* enzymes, *Phosphadases* and *neurotoxins*. Amina Devi[3] has given the details of the definite constituents, and Karlsson[4] has studied in details the neurotoxins.

According to Amina Devi, the nitrogen content of the Cobra (Naja naja) venom was 16.8% and that of Russell's viper was 15.8%. The phosphorus contents were (as salts) 9.36/100 mg and 13.02/100 mg respectively. Russell's viper venom had 0.29% chlorides, 1.42% sodium, 0.86% calcium, and 0.016% cobalt.

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[1]Kellaway (1939).
[2]Porges (1963).
[3]Amina Devi (1968).
[4]Karlsson (1971).

The principle protein factor was *Neurotoxin*. This has been isolated from Cobra venom, and Karlsson has found 71 aminoacids in it. These proteins exert various actions on the nerve tissue producing *Curare* like effect as well as paralysis. They cause respiratory failure, acting on the diaphragm too. The Cardiotoxin even at a dilution of 1/50,000 throws the heart of a frog into systolic contractures. When put in blood stream there is a drop in blood pressure. Another protein *Hemolysin* releases haemoglobin from erythrocyte stroma. *Coagulin* shows clot promoting factors like trypsin. It transforms fibrinogen into fibrin and converts pro-thrombin into thrombin. Anticoagulant activity of the venom has an inhibitory effect on thromboplastin. Nerve growth stimulating factor for sensory and sympathetic ganglion are similar to the tissue forming mouse sarcoma. *Crotamine*, produces paralysis of the posterior extremities and causes difficulty in respiration. Antigenic and Allergic compounds produce anaphylactic reactions.

The enzyme constituents have been identified as *Proteases*, *Phospholipase-A*, *Cholinesterase*, *Ophio-Amino-oxidase*, *Nucleases*, *Hyaluronidase*, and *Pyrophosphatase*.

Proteases :–These endopeptides are trypsin like and are highly powerful in necrotic formations. Necrosis is quickest by snake venoms, it is highly useful to digest the tissues. These activities coagulate blood by virtue of their ability to convert either prothrombin to thrombin or fibrinogen to fibrin. These venoms exhibit proteolytic and esterase activity. The venom of Russell's viper can indirectly cause death by blocking blood circulation, later producing necrosis.

Phospholipase-A in snake venoms has the ability to dissolve erythrocytes. They have the ability to hydrolyze lecithin into lysolecithin which dissolves erythrocytes.

Cholinesterase activity present in cobra venom is capable of hydrolyzing acetylcholine; the latter plays an important role in the transmission of nerve impulses. It has a curare-like action and can block the transmission of nerve impulses.

Ophio-Amino-Acid oxidase can activate proteases and peptides bound up in the cells. It hastens autolysis and putrification in viper venoms.

Nuclease; Ribonuclease and *Deoxyribonuclease* in snake venoms are capable of hydrolyzing phosphodiester bonds in

DNA and RNA. The Indian Cobra has the highest R Nase activity and they are a rich source of *Phosphodiesterase* etc. the activity of these enzymes supplements the hydrolysing activity of other enzymes in the venom.

Erepsin is found as one of the constituents here.

Hyaluronidase. Hyaluronic acid has the important function of resistance to penetration by foreign matter. This resistance is broken down under the influence of hyaluronidase. It helps preparing the ground for the spreading of toxic factors.

Deoxypolyribonucleotides are destroyed by DPN-pyrophosphatase, so that enzymes which are vitally important in the execution of many reactions of glycolytic and citric aid cycles are deprived of the latter.

From the above review it is apparent that nature has provided the snake with all the powerful enzymes to hydrolyse *Adenosine triphosphate*, and others, the products of hydrolysis of ATP and AMP are such that they are themselves toxic in as much as they depress blood pressure.

Broadly speaking then there are certain groups of snake venoms. Those with coagulent properties could be divided into two groups. The first are the ones with powerful proteolytic activity which convert fibrinogen into fibrillar gel. These are seen in vipers. The second group converts prothrombin into thrombin. These proteolytic enzymes contribute to the hypertensive action of the venom, through the damage to muscular endothelium thereby the blood escapes from blood vessels and probably histamine is liberated. This is seen in cobra venom which is more active in dilute solutions, because lecithin is absorbed by proteins which coagulate in the concentrated venom.

Phospholipases cause haemolysis and show most of the effects on the heart and circulation.

Neuro-toxins exert various actions on the nervous tissue and produce curare like effect as well as paralysis by cobra venom.

Thus it will be seen that the venom primarily helps in digestion. These powerful enzymes therefore have a strong effect. The hyaluronidase help in spreading the venom and ophio-oxidase in autolysis and putrefaction. Neurotoxins paralyse the prey. Lecithinase attack the lipid layers of the

endothelial cell linings, producing lysolecithin and helping in the increase of fragility and permeability for breakage of cells. Proteases lead to dissolution of blood vessels and spill over of erthrocyte and serum in the tissue. Thus the venom constituents have toxic action, enzymatic activity and other diverse properties responsible in aiding digestion.

Symptoms of Poisoning

Normally one gets bitten in the extremities of limbs. If any person is ever bitten directly into an important blood vessel like the jugular vein or the carotid artery, etc., which is an extremely rare possibility, the symptoms may start immediately and the effect will be almost instantaneous. In the case of Russell's viper if the venom has thus gone into direct circulation, violent convulsions set in rapidly and death follows immediately.

A majority of snakes are non-poisonous but even then a non-poisonous snake-bite may cause psychological shock and death.

A non-poisonous snake can transmit tetanus or gas-gangrene in the wound inflicted. Also a poisonous snake may not have put in a lethal dose of venom and in such cases, the patient may not show all symptoms. If a poisonous snake has struck and a sufficient amount of venom has been injected, one should expect the following general symptoms for treatment.[1]

Cobra

If the venom has been injected local symptoms start within six to eight minutes:

1. The spot develops a small reddish wheel and is tender. There is some sensation and slight burning pain at the bitten spot.

2. After about 25 minutes, constitutional symptoms begin to appear, The patient feels sleepy, slightly intoxicated, weak in the legs and shows a disinclination to stand or move.

3. After 35 to 50 minutes, there is profuse salivation and even vomiting. This is followed by a paralysis and swelling of the tongue and the larynx. Thus he cannot swallow or speak coherently.

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[1]Essex, H. E. (1945).

4. After about a couple of hours, the paralysis is complete. Respiration becomes slower and the action of the heart quickens. The patient is conscious, but is unable to speak.

5. Finally, respiration ceases with or without convulsions and the heart soon stops.

Krait

In the case of this snake bite, the symptoms are similar to those of a cobra bite, except that there is no swelling or burning pain at the bitten spot and the convulsions are milder, while the feeling of drowsiness and intoxication is more intense. Albumen may be detected in the urine.

Russell's Viper and Echis carinatus

1. The spot develops a severe pain within eight minutes. The area around the injury is red and painful.

2. The onset of swelling starts within 15 minutes and there is often a blood-stained discharge from the wounds.

3. There is intense pain, thready pulse, cold sweat, vomiting, followed by dilated pupils getting insensitive to light.

4. In about an hour or two, there is a marked collapse and often complete loss of consciousness.

5. In case the above symptoms show a sign of improvement, the local symptoms start playing an important role in the former case. There is a large exta-vasation of blood followed by oedema all round the wound with a general increase in the swelling.

6. Towards the end there is an extensive suppuration and sloughing, followed by a malignant oedema. This is followed particularly in *Echis* by severe haemorrhages from rectum and other orifices in the body.

There is no paralysis in the case of these snake bites.

In the case of *Echis* the patient may not die, but the secondary symptoms continue for days, as he goes on bleeding from different orifices, even from gums and the wound shows mild symptoms of necrosis. We have seen in a recent case of Russell's viper bite that the bitten spot on the skin became dark after four days and the necrotic area had to be cut out. Antivenin had been given but not infiltrated on the bitten spot (*Plate 22*). In the case of viper poisoning the blood clotting

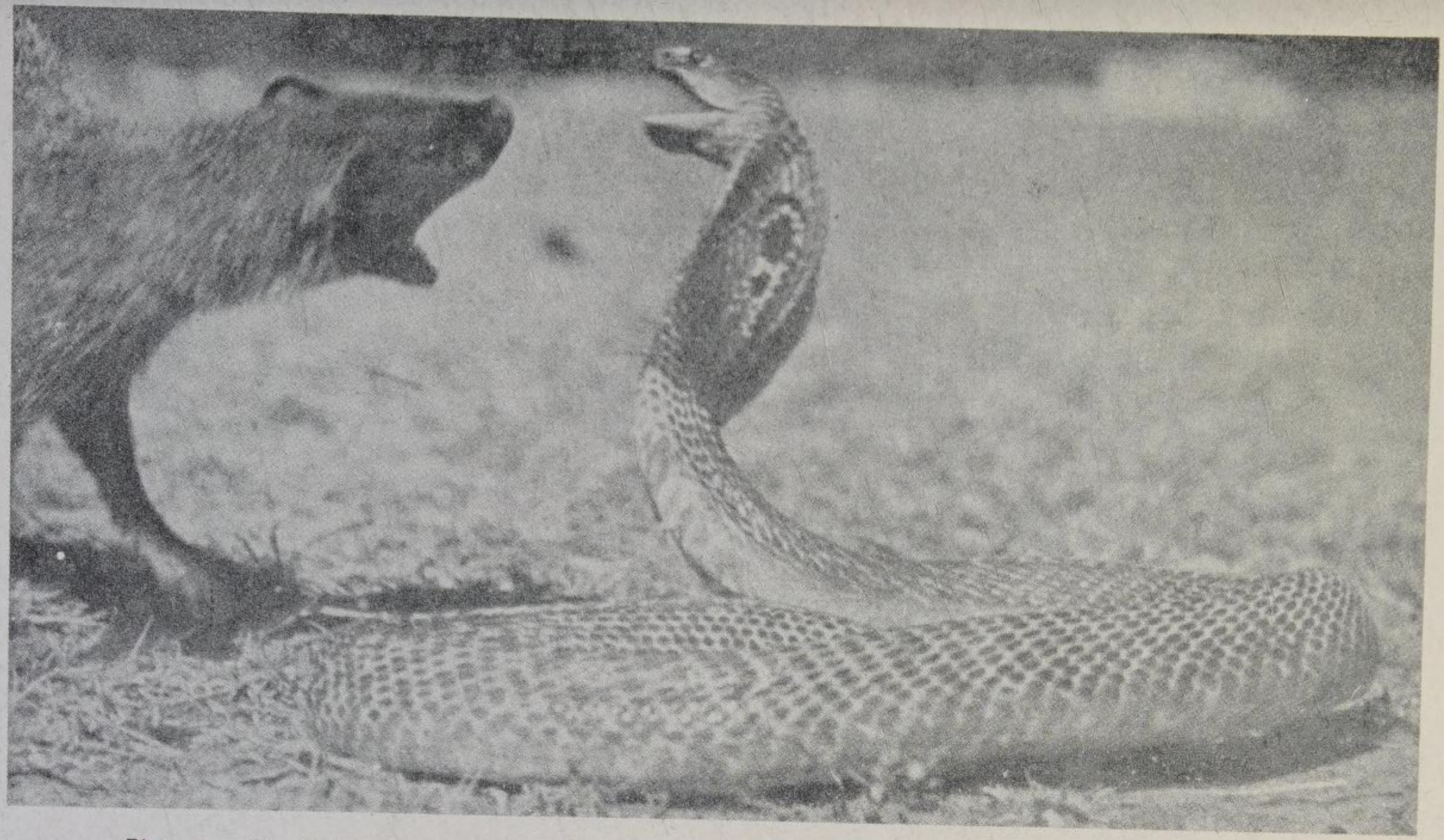


Plate 1. The fight between a cobra and a mongoose. The latter normally wins the fight by sheer agility. It kills the cobra by burying its incisor-teeth behind the head of the snake and severing the vertebral column from the cranium. During the fight in nature, the mongoose is seen rushing to dig grass roots, apparently to sharpen the teeth.

Plate 2. Cobras being "charmed" by a gourd;
a sight quite common in India.

Plate 3. Falcon bird.

Plate 4. Kaliya mardan. The subjugation of the Naga "Kaliya" by Lord Krishna.

Plate 5. Shesh-shai. Lord Vishnu resting on a many-headed cobra that lies in an ocean of milk.

Plate 6. Hooded serpent images under a Ficus tree in Karnataka State. Note the coiled snakes and also the female face with a coil below.

Plate 7. Naga raja with seven-headed cobra hood over his head. His consorts have one-headed cobra hood. Cave No. 19 at Ajanta.

(Photo: Mukul Dey).

Plate 8. Sanchi. (Main stupa) Torana on the Western gate. Naga raja with a five-hooded cobra as a headgear while his consorts have a single-hooded cobra headgear. This last can clearly be seen in profile on the right-hand side.

Plate 9. At Shirala in Maharashtra trained people collect Cobra Snakes and keep them in a mud pot covered by a cloth till the Nagpanchmi day. They then release the cobra in the open, and make it shake thé hood by swaying white painted mud pots in front of him.

Plate 10. Snake god temple. Maharashtra, Snake images.

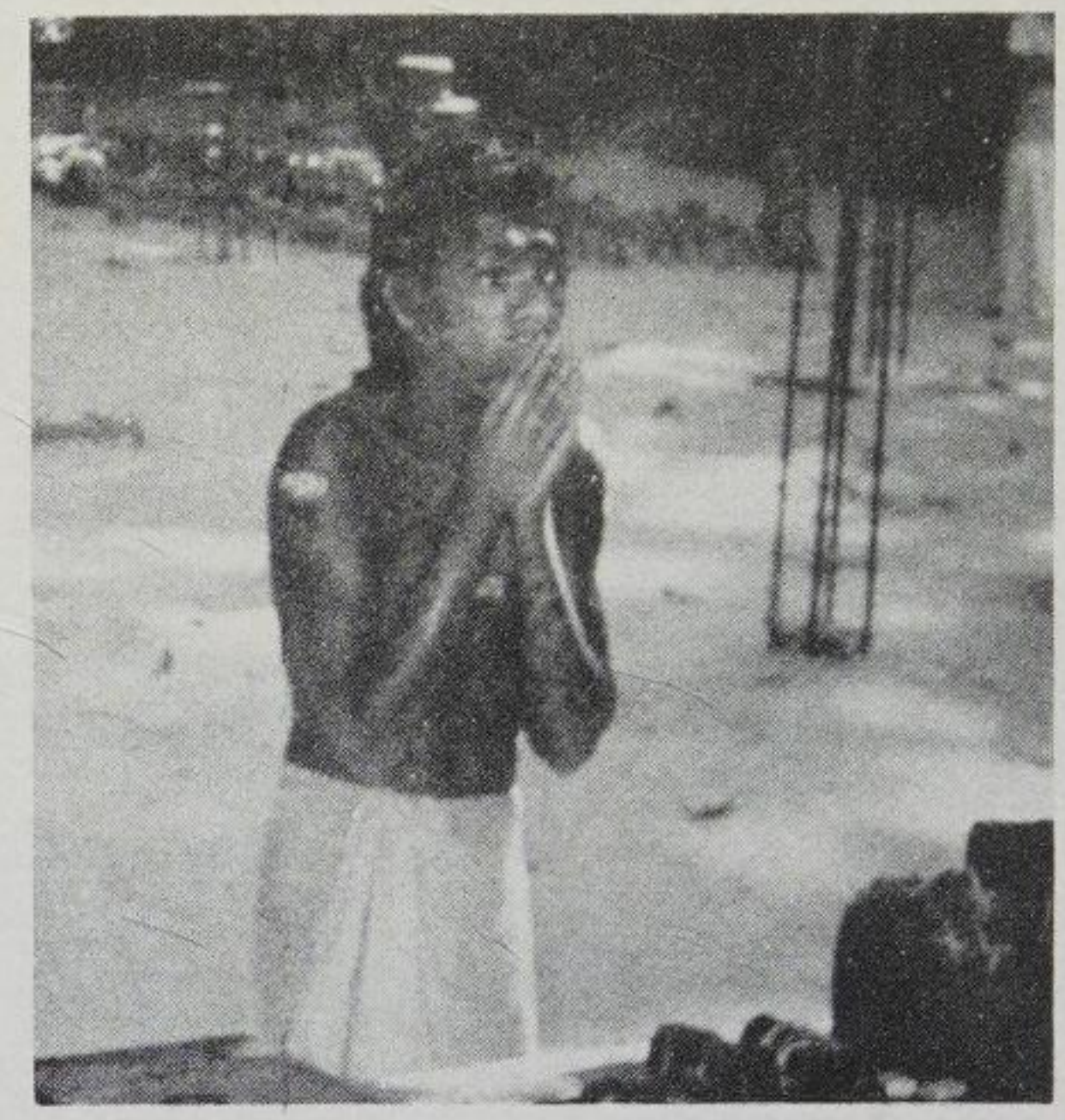


Plate 11. People suffering from Psoriasis visiting the Snake temple in 'Manarshala' in Kerala for its cure.

Plate 12. Live Cobra Snake being worshipped on a Nagpanchami day. Note the charmer getting the hood raised by making a sound with his fingers and the lady sprinkling 'kum kum' on the hood.

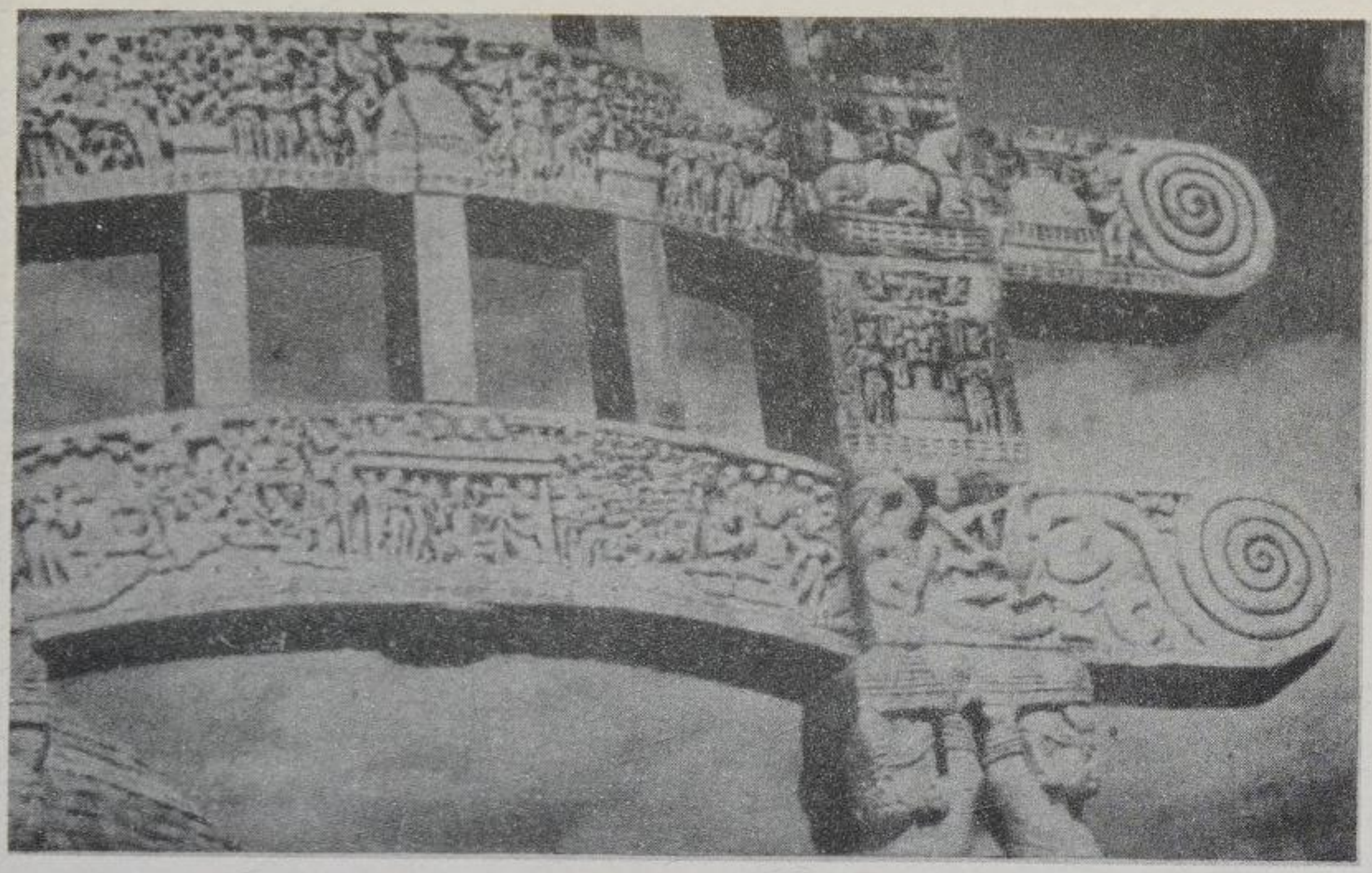
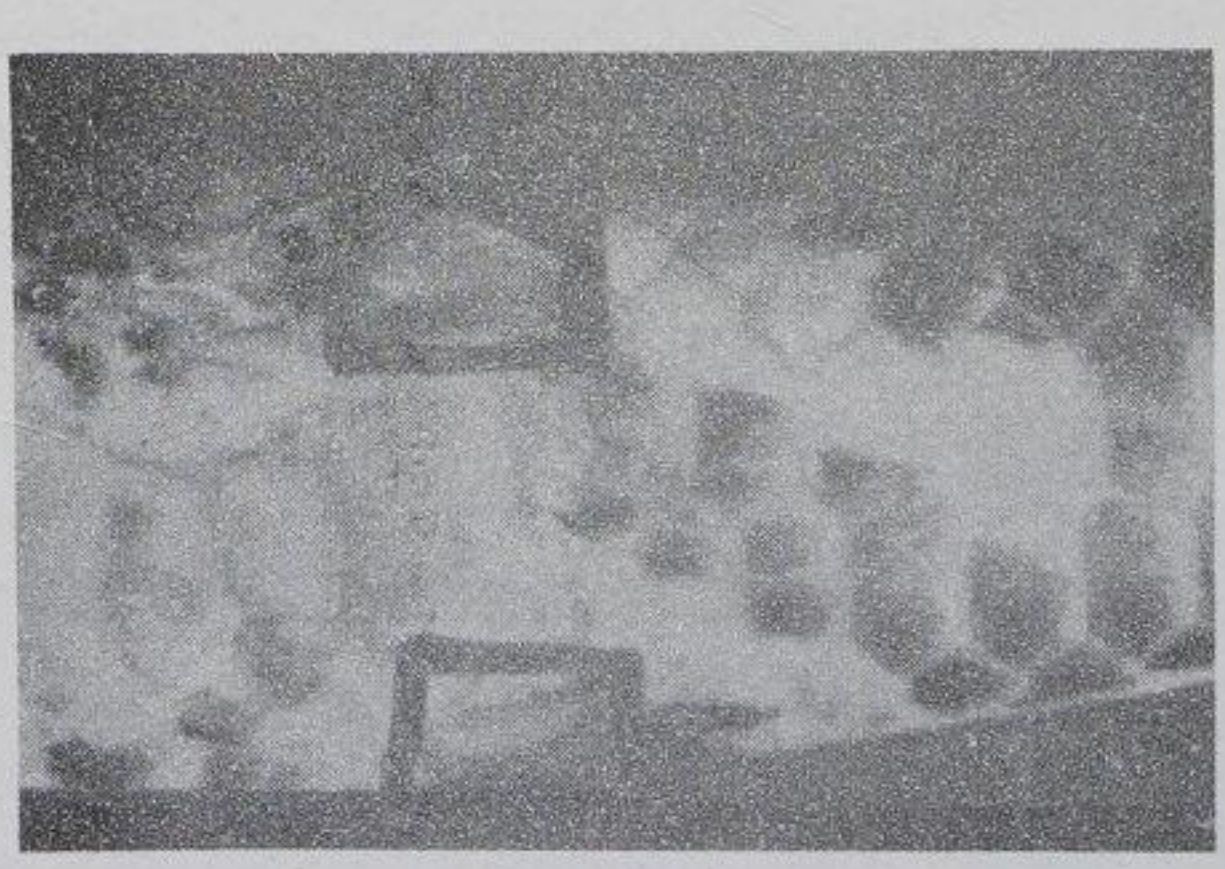


Plate 13. Sanchi (small stupa at the entrance of the main stupa). Main torana lower rail, right and left-hand corners depict a Naga raja with a five-hooded cobra head-gear and his consort.

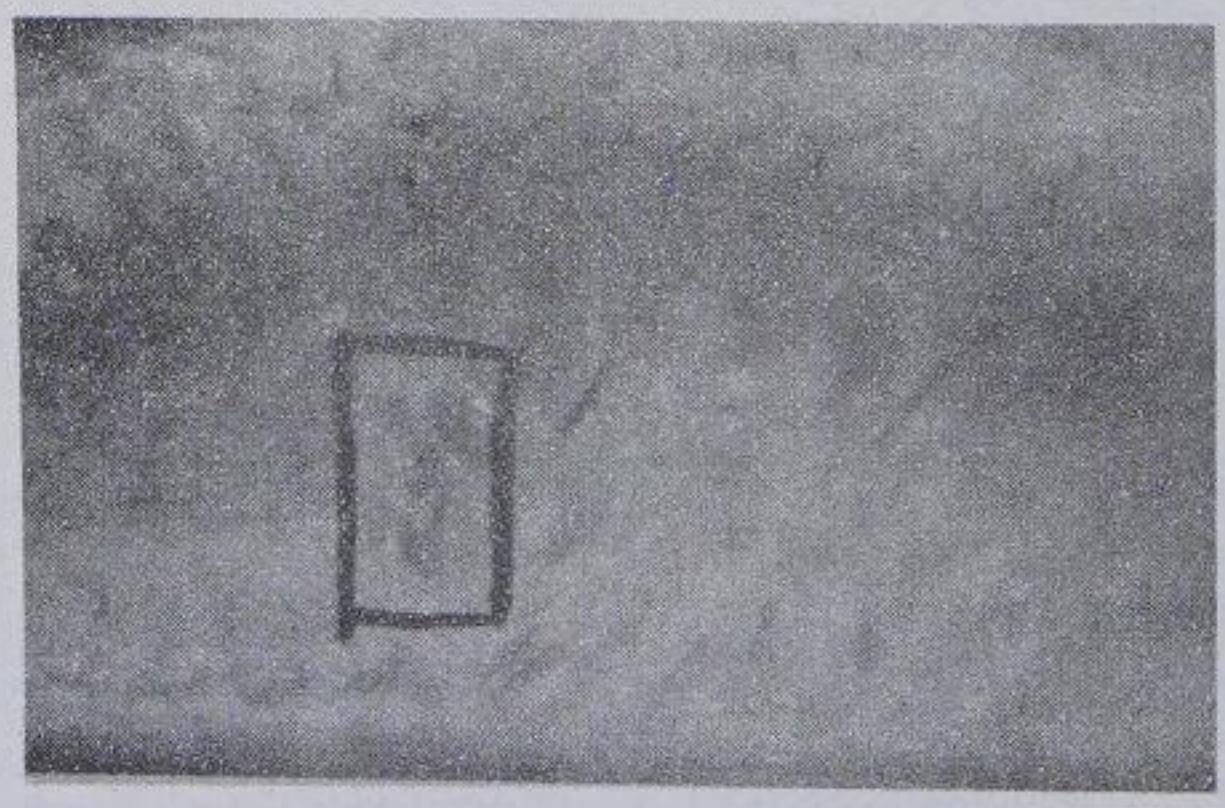
Plate 14. Sanchi (small stupa at base and west of main stupa). Part of the western rails of the torana showing a round disc representing the sun inside which is shown a five-hooded cobra with a bifurcated tongue. The female figure standing at the side holds a garland in her hand.

Plate 15. X-ray photograph of a two-headed king-snake–to show that it is only a monstrosity and that there is nothing fearful about this freak.

(Photo : San Diego Zoo)



(a)



(b)

Plate 16. (a) Anal spurs as appendages of a python.

(b) Internal appendages in Typhlops.

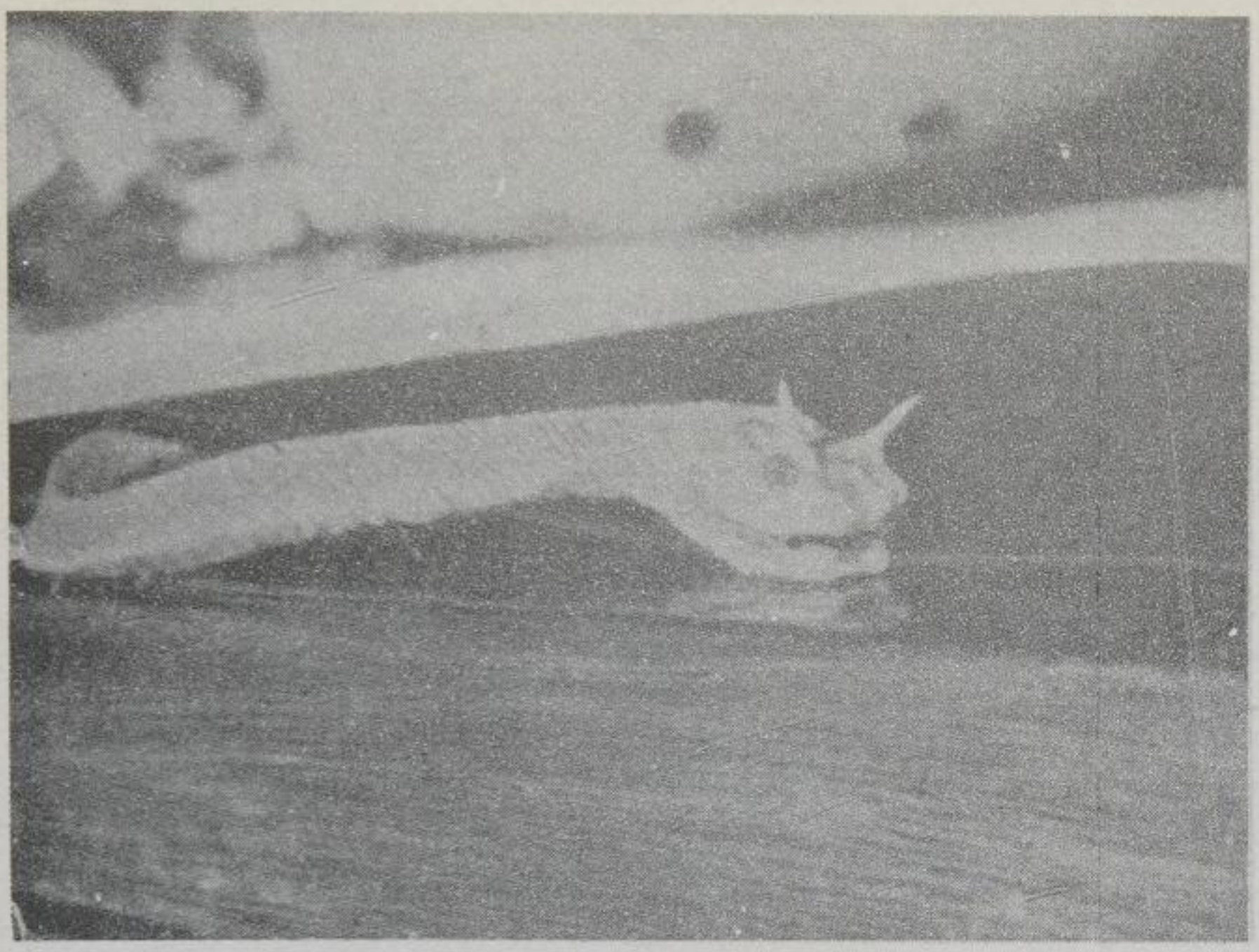


Plate 17. "Horns" on the head of Pseudocerastes persicus.

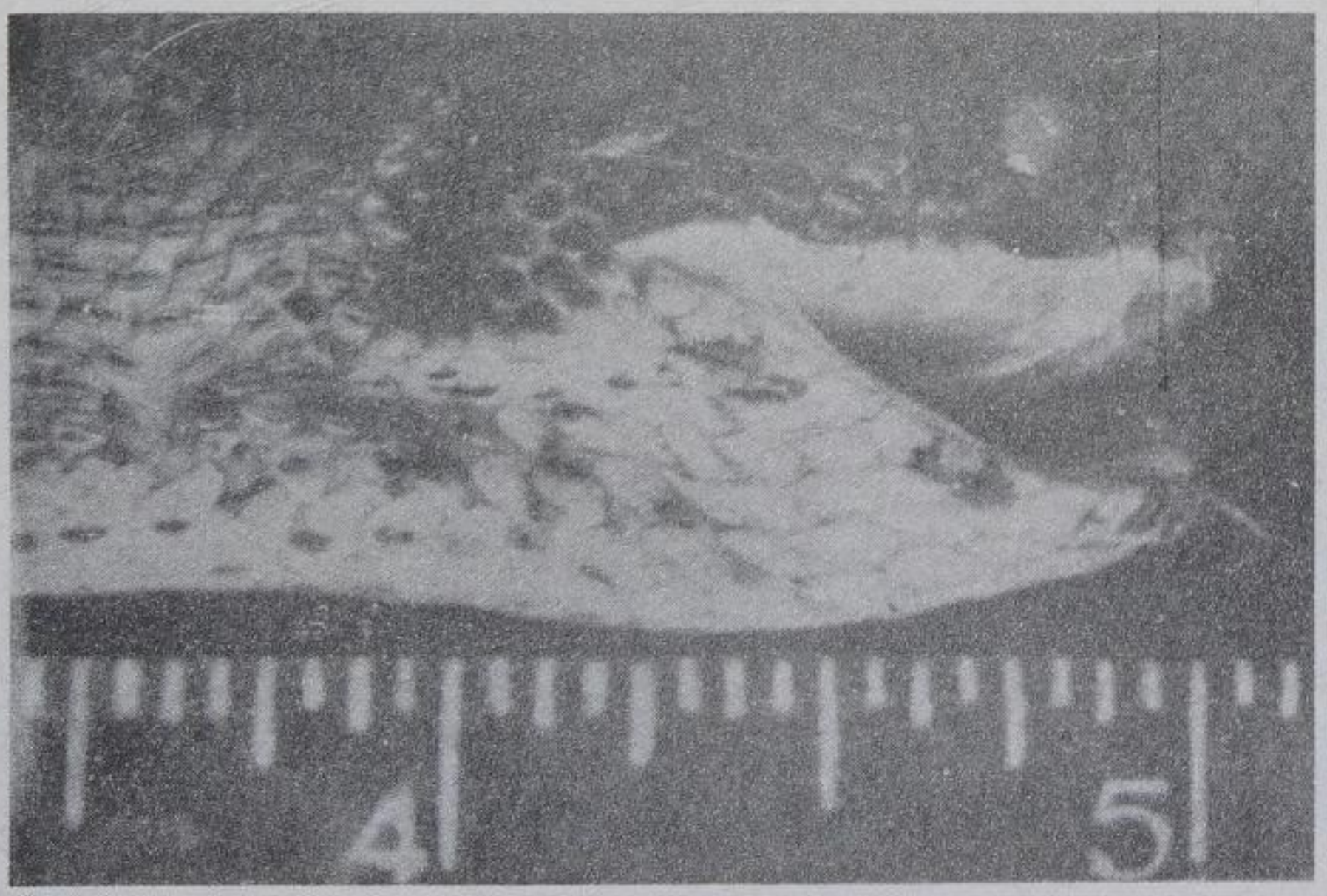


Plate 18. Keeled and serrated "saw-scaled" scales of Echis carinatus.

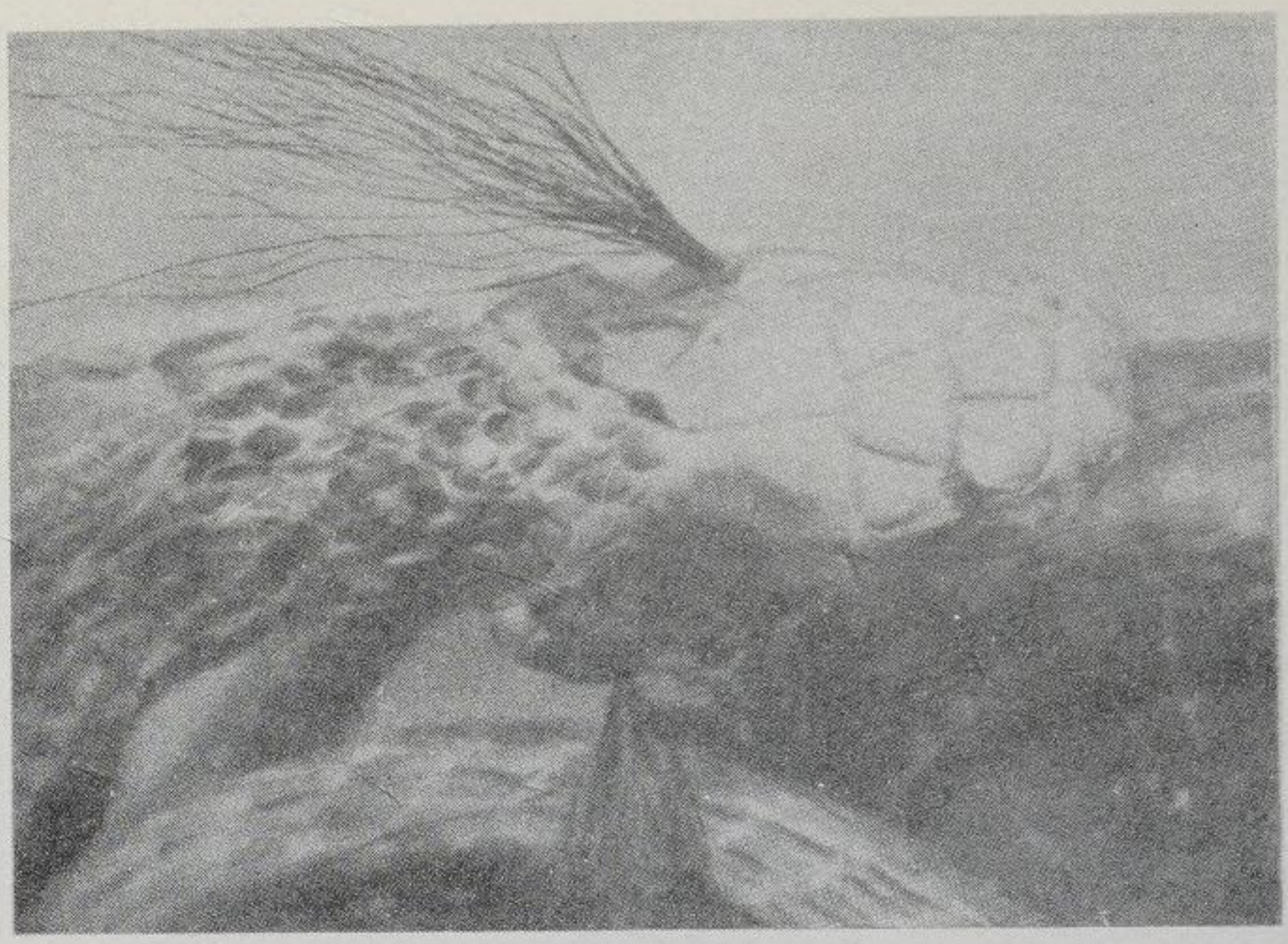


Plate 19. "Hairs" planted on a cobra head.

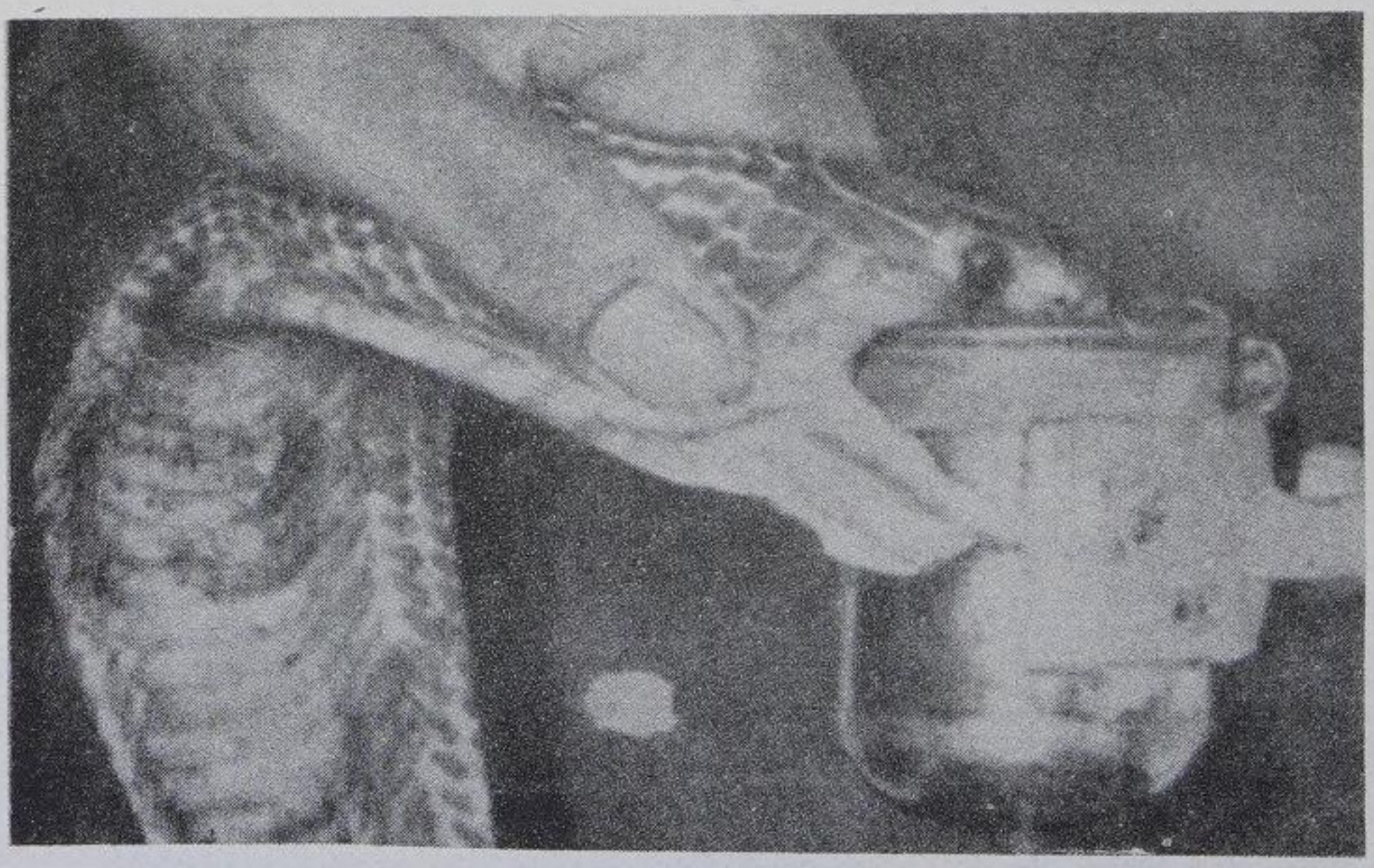


Plate 20. Extraction of cobra venom. The snake is made to bite a plastic cloth tied tightly over a wine glass.

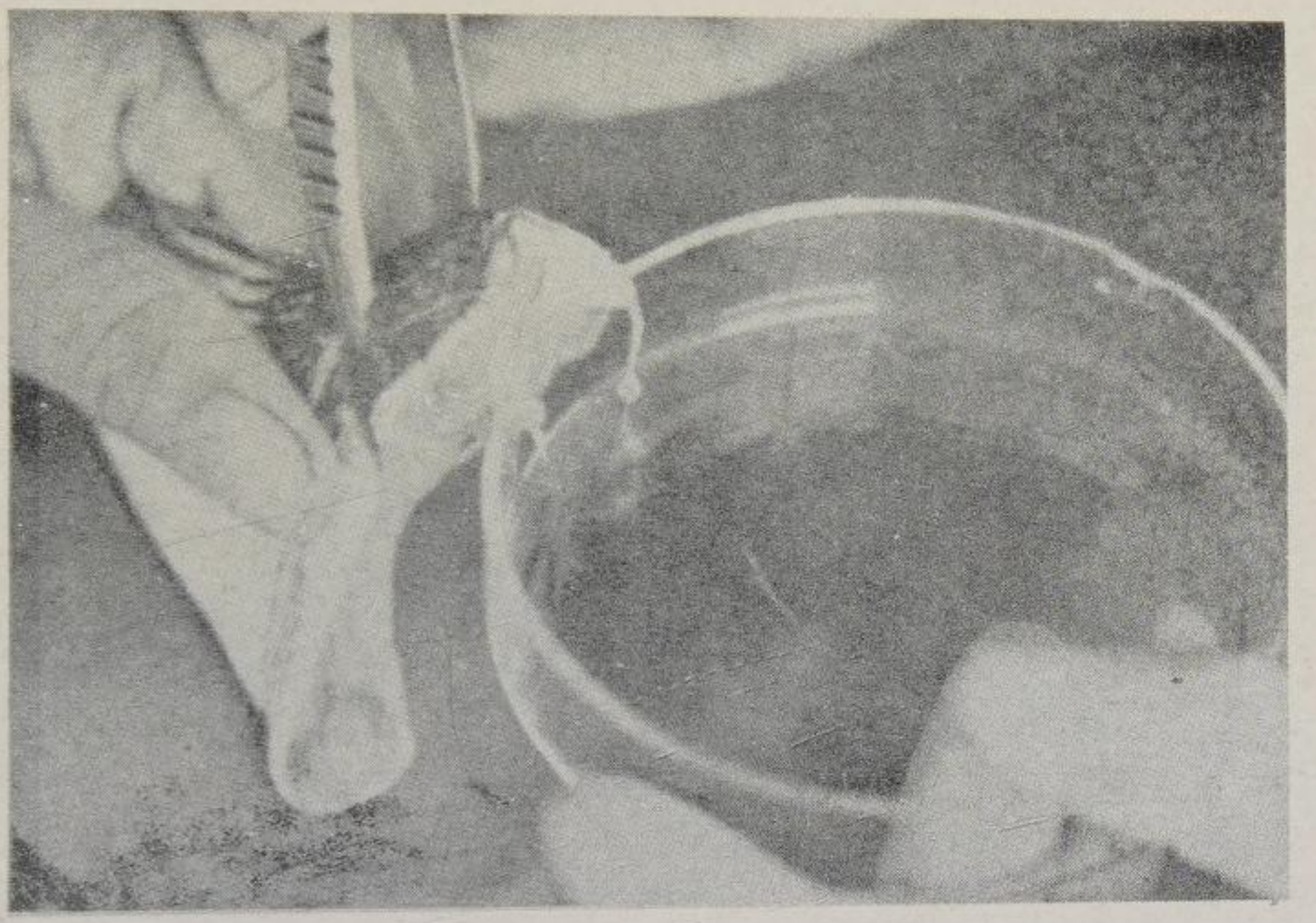


Plate 21. Extraction of venom from a Russell's viper. The fangs being big and in sheath are allowed to strike a petri-dish.

Plate 22. Damage caused to the hand of a patient six days after bite of a Russell's viper, where antivenin had not been infiltrated at the site of bite.

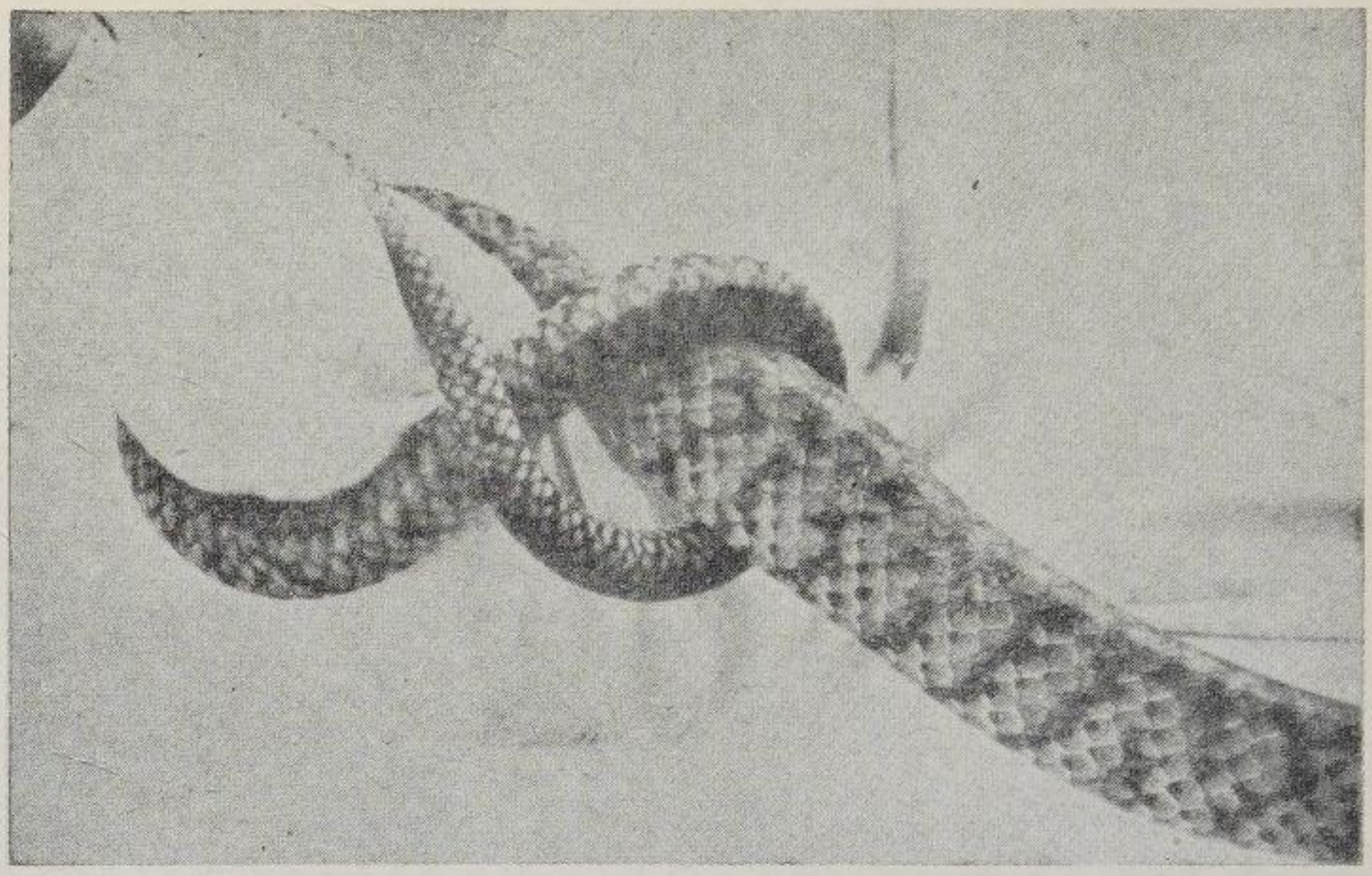


Plate. 23. Rat snake tying a "scout" type of knot.

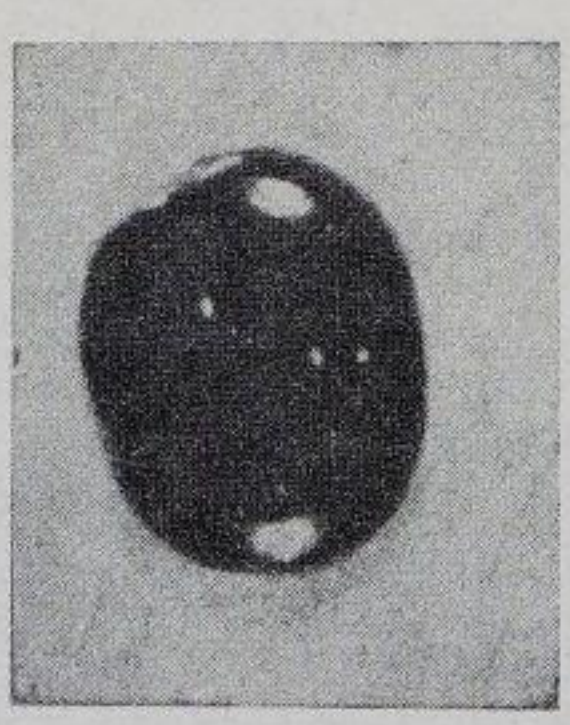


Plate 24. Snake "Jewel".

is delayed. In severe cases of Russell's viper bite the kidney cells are badly damaged and may not recover even after a long treatment.

A patient bitten by *Echis carinatus* was admitted to a hospital in Bombay. He had not been given an antivenin. He was complaining of retention of urine and bleeding from gums and had heavy oozing from injection marks when an antibiotic had been given. His examination in Pathology indicated that he was suffering from *Hypochromia* and *Thrombo-cytopaenia*. His blood clotting time had gone down to 25 minutes, while it should be 5 minutes. His blood picture showed that he had 3120,000 RBC, 8100-WBC, 8.5 gm% *Haemoglobin*, 55.5% *Neutrophil*, 0.05% *Eisonophil*, 0% *Basophil*, 42.0% *Lymphocytes*, 2% *Monocytes* and a very few platelets.

He was given 20 c.c. of antivenin and was kept on a continuous blood transfusion. On the second day the oozing of blood from nose, gum, and urine was reduced. After 10 days of blood transfusion he was discharged in 16 days.

Russel's viper bite–case history

One laboratory assistant while handling a Russle's viper got bitten on the upper side of the palm between the middle and the index finger. This was on 21 August at 10 a.m.

At 10.15 a.m. he was removed to a hospital and 10 c.c. of an antivenin was given after testing his sensitivity. He complained of an intensive burning pain at the site of bite, which was showing a marked swelling.

At 10.25, the second dose of antivenin was given and this was also infiltrated at the site of bite. At 10.45 he complained of intensive burning pain and his fingers and arm were swollen up to shoulders. There was oozing from the site of bite.

At 11.30, the patient was groaning in pain, and the swelling had spread to the chest and right side of the face. 10 c.c. of antivenin was given and salt gauze was applied to the wound that was oozing.

At 13.00 hours, the entire right hand of the patient was stiff, the body on the right side was swelling, but the intensity of the pain was reducing.

At 20.00 hours the pain was much reduced. A blister had formed at the site of bite. The clotting time of blood was recoded at 12 minutes. The patient slept fairly well.

On 22 August at 6.00 a.m. there was no pain in the wound. The swelling on the body had not subsided. The site of bite showed black spots. Traces of blood were seen in the urine.

At 10.00 a.m. the black spots indicating necrosis had increased in size. The swelling on the face had been reduced. There was no pain.

At 16.00 hours the necrosis was clear on the finger which was now stiff. Swelling was reducing. He slept weil. On 23 August at 06.00 hours the finger side and tips were black. Swelling reduced, only seen on palpitation. Blood clotting time was 9 minutes. Urticaria due to serum reaction seen on the body. Calcium gluconate 10 cc. given.

On 25 August at 08.00 hours necrotic part was removed and a skin graft given from the arm of the patient.

It took 10 days for the skin graft to be healed. The finger now remained stiff with restricted movements. The patient was discharged after the clotting time became normal.

First-Aid

Snake bite should be treated immediately. The following first-aid measures have proved of some value :

Ligation : A ligature of some type should be tied a little above the bitten part. This would prevent the venom from being absorbed into the upper part of the limb. The ligature may be a strip of cloth, a large handkerchief, or even a piece of heavy cord. A rubber ligature is the best. It is necessary to make the ligature sufficiently tight to cause a stoppage of circulation. The ligation should not continue for more than twenty minutes and should always be slackened off every ten minutes during this time.

Incision : After retarding the absorption of poison in this manner, the fang-wounds should be opened by cross incisions 1 cm long and 1 mm deep over each fang mark. The incisions should be made with care by a sterile stainless steel knife or lancet so as not to injure the delicate membrane covering a bone or cut into a blood vessel.

Suction : Drainage of blood and lymph from the cuts should be induced by suction. This is more useful in viperine bites. Suction should be done mechanically by means of a cupping device which consists of a glass or metal cup with a rubber suction bulb attached to it. There should be at least two different sizes of cups in a snake-bite kit, one of glass with a round opening of about one inch diameter for flat surfaces and another of metal with a narrow oval opening for fingers and other round parts. Mechanical suction should continue several hours after ligation has ceased. During intervals, the incisions should be covered with pieces of cloth dipped into a solution of table salt or Epsom salt in water. This will promote drainage of lymph by osmosis.

Caution : It will be desirable to wash the incisions with a weak solution of potassium permanganate crystals in pure water. This solution should be pale amethyst hue. The solution will also neutralise the local venom by oxidation. But it is very dangerous to apply crystals or strong solution of potassium permanganate to the wounds. Cauterizing the wounds is worse still as it actually seals the deadly poison within the tissue. The function of the solution is to prevent infection.

It may be well to remember that if nothing happens within ten minutes following the bite, the snake was harmless or had poured no venom when it bit.

It is now established that first-aid may not be fully useful in the case of neurotoxic poisons. Anyway it will be sufficiently effective psychologically. Secondly, it has also been shown now that these extra incisions in the case of viperin poisoning often create further local symptoms. Cryotherapy has been advised by some workers. Herein the bitten parts are tried to be frozen immediately to prevent further absorption of the venom in the tissue. But in this case also there are chances of complications in local symptoms. The only sure remedy is the specific serum treatment.

In fact in Brazil they advocate immediate injection of the serum subcutaneously, in the muscle region below the scapula.

Specific Serum Treatment

Once the venom enters the circulation, it is only the anti-snake-venom serum that can neutralize it. The serum should

be injected immediately after the bite. As a first dose, at least 10 cc of the reconsituted serum should be injected intravenously. The second dose should be repeated one hour after the first dose or even earlier, if symptoms persist. If the symptoms, which vary with different venoms, indicate persistence of venom action, further doses should be repeated every two hours until the symptoms completely disappear. In the case of a viper bite some serum should also be injected round the site of the bite, to prevent gangrene which otherwise results owing to the very destructive effective of localized viper venom on the tissues.

Polyvalent anti-Snake Venom Serum

In India at the Haffkine Institute, the anti-snake-venom serum is prepared by hyper-immuning horses against the venoms of the four common poisonous snakes : (1) Cobra (*Naja naja*). (2) Common Krait (*Bungarus caeruleus*) (3) Russell's viper (*Vipera russelli*) and (4) Saw-scaled viper (*Echis carinatus*). Plasma obtained from the hyper immunized horses is concentrated and purified. Each c.c. of the concentrated serum neutralizes not less than the following quantities of dried venoms, when the serum is injected along with the venoms intravenously into white mice : Cobra 0.6 mg., Common Krait 0.45 mg., Russell's viper 0.6 mg., and Saw-scaled viper 0.45 mg.

The Haffkine Institute report mentions that 1 ml of their polyvalent antivenin was able to neutralize 0.5 mg. (20 mld.) of a King Cobra venom (Naja hannah).[1]

The serum is lyophilised by drying it from the frozen state under high vacuum. The drying process is continued until the moisture is reduced to less than 1 per cent. The dried serum, however, retains its affinity for water to the fullest extent and therefore dissolves rapidly on adding water. This property continues to be active for years.

Intravenous injection of serum in horse-serum sensitive subjects can produce very severe serum sickness and even acute anaphylaxis. Every care should be taken to prevent these reactions.

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[1]Haffkine Institute Report (1958, p. 5).

Intramuscular or subcutaneous injections of the anti-snake-venom serum are not as quickly effective as intravenous injections. But if expert medical aid is not available, the serum may be administered by the subcutaneous or the intramuscular route. The dosage should then be increased to two to three times of that recommended for adminstration by the intravenous route.

Prevention of Serum Sickness

In administering any horse-serum product for therapeutic purposes, certain precautions must be taken, particularly in the case of patients known to be sensitive to horse-serum. However, persons dangerously hypersensitive to horse-serum are exceedingly rare and therefore when there is a definite indication for any anti-sera, the treatment should not be put off on account of the probability of an anaphylactic shock. It must be emphasized that grave disadvantages may result to the patient concerned by exaggerating this possibility and postponing serum treatment.

Precautions

It should be ascertained if the patient has ever been treated with any horse serum product. History of personal or hereditary allergy, if any, should also be carefully noted. If the patient has, at any time previously, received an injection of horse anti-serum or if he has ever displayed an allergic reaction caused by proximity to the horse, the intradermal skin test, and if necessary, also the ophthalmic test for sensitivity to horse serum must be done.

Intradermal Skin Test

This test is given by injecting intracutaneously into the flexor surface of the forearm, 0.05 cc to 0.1 cc of 1:10 dilution prepared from a portion of the therapeutic serum to be administered. Positive reaction is indicated by a rapid enlargement of the primary elevation which becomes urticarial in appearance surrounded by a zone of erythema in about five to twenty minutes. A ring, one centimetre in diameter,

surrounded by an erythema of about the same width is significant. Erythema is hardly noticeable in a deeply pigmented skin. In such cases, appearance of the wheal only should be taken into account. Pseudopodial extensions of the central wheal are evidence of a higher or more dangerous degree of sensitivity.

If the test is negative, the elevation due to the injection disappears in a few minutes.

Normal horse-serum should never be used for giving the subcutaneous skin sensitivity test. But a portion of the antiserum to be injected should be utilised. In extra susceptible patients an injection of even 0.1 cc of 1:10 dilution of normal horse serum may cause fatal anaphylaxis and severe serum reactions.

Ophthalmic Test

The lower lid of the eyes is everted and one drop of undiluted therapeutic serum is placed into the conjunctival sac. A positive reaction is indicated by itching, burning, congestion and lacrymation appearing within ten to twenty-five minutes. A drop of adrenalin choloride solution 1:1,000 will relieve the symptoms and should be put into the conjunctiva in every positive case. A positive ophthalmic test indicates a dangerous degree of hypersensitivity. Utmost care and precaution are therefore called for in administering serum to patients showing the positive ophthalmic test.

Desensitization of Serum sensitivity

If the skin test, or the ophthalmic test is positive, the patient should be desensitized. In case of a mild skin reaction and negative ophthalmic test, 0.5 cc to 1.0 cc of antiserum is injected sometime before the administration of a full therapeutic dose. In case of a severe skin reaction and positive ophthalmic test, 0.1 cc of the serum is injected subcutaneously. The dose is doubled every half hour until the full amount is administered. After this preliminary desensitization subsequent injections may be given by any route and in full doses. It must be remembered that the patient becomes serum sensitive again a few weeks after this desensitization.

Care in Injection of Antiserum

Intravenous or intrathecal injections must always be given slowly, preferably by the gravity method. If conditions permit, these injections should be preceded by an initial treatment given intramuscularly a few minutes previously. While injecting intravenously, the antiserum should be diluted 1:5 to 1:10 with sterile pyrogen-free physiological salt solution. While injecting intrathecally, at first only a few drops of the diluted serum should be administered and with the needle still in the spinal canal, the patient should be observed for five minutes to see if any reaction occurs before completing the injection.

The following two methods have also been recommended in the case of persons sensitive to serum :

1. 10 cc of the polyvalent antivenom may be given in an intravenous drip in 100 cc of glucose saline with Vitamin C, calcium and coramin. There should, of course, be a separate injection of adrenalin before the drip starts. Some doctors advise a subcutaneous injection with hyalase.

2. (a) Inject 1 cc coramine intramuscularly.

(b) Inject 1cc adrenalin or any antihistamine intramuscularly.

(c) Observe the serum sensitiveness of the patient, inject 0.5 cc of the serum slowly subcutaneously.

(d) If the person is sensitive, inject 1 cc subcutaneously, after two minutes inject 2 cc by the same route and wait for fifteen minutes. Inject 10 cc subcutaneously and wait for thirty minutes. Inject 40 cc subcutaneously very slowly and wait for ten minutes. Inject 10 cc again by intravenous route and wait for fifteen minutes. Inject 10 cc again by intravenous route and wait for one hour to observe further symptoms.

However, adrenalin and coramine should always be ready at hand for administration in 1 cc^3 doses.

Treatment of Serum Sickness

With the first symptoms of serum reaction, 0.5 cc to 1.00 cc of adrenalin chloride solution 1 in 1,000 should be injected subcutaneously. For children 0.2 cc to 0.33 cc is usually an adequate dose. Lotio calaminae and cold applications about the point of injection are of benefit. Sodium bicarbonate bath may be used. Fluid should be injected sufficiently and free

elimination should be encouraged.

In the case of accelerated reaction, which is usually observed in those who have received serum at some previous time, adrenalin chloride solution treatment should be used more actively. This develops in two stages. The primary reaction is local and occurs a few hours after injection. The secondary symptoms of more pronounced serum sickness usually appear four to seven days after injection.

True cases of acute anaphylaxis are rare. The symptoms of acute anaphylaxis develop very quickly after serum treatment, usually within a few minutes of starting the injection. This must immediately be discontinued and a tourniquet applied proximal to the point of injection. Adrenalin should be injected immediately at some point other than where the tourniquet has been applied and repeated at frequent intervals. After the control of acute symptoms sedatives may be given.

Sometimes there is sloughing of the tissues at the injected spot due to local anaphylaxis. Such reactions may be avoided by the selection, for re-injection of antisera, to only those sites that have not received any injection of antisera previously. If sloughing occurs, the part should be elevated and treated with iced compresses and sulphathiazole paste.

In some cases signs of serum reactions appear number of days after injection of serum. They are usually very mild and pass off without any treatment and should, therefore, cause no apprehension.

Associated Treatment

In case of Russell's viper and Saw-scaled viper poisonings, sedatives such as morphine, small doses of barbiturate or aspirin may be given to relieve pain and nervousness. They should, however, be used with care in cobra and krait poisonings. In case of collapse, strychnine, pituitrin or other general stimultants are of special value. In all cases of severe poisoning great relief is likely to be experienced from the infusion of a large amount of physiological saline, or better still, transfusion of blood or plasma, the effects of which may be life-saving in border-line cases.

Dr. Douglas ; Cable and others have published a paper entitled "Prolonged Defibrination After a Bite from a Non-poisonous Snake" in JAMA, *251* (7) : 925 on February 17th : 1984. The snake-bite was from *Rhabdophis subminatus* and the patient could be saved by supportive RBC transmission.

During our studies on the toxicity of the parotid gland secretions of a number of snakes, we found that this secretion from the rat-snake *Ptyas mucosus* was toxic to a mice at a dilution of 1:10. Similar results were obtained for *Dryophis nasutus*, the common green whip snake.

Research work is in progress at many institutions to isolate the toxic constituents from the salivary secretions of the so called non-poisonous snakes.

In view of the above recent findings, it is desirable to be careful when handling even non-poisonous snakes, especially colubridae. However, tetanus, gas-gangrene and a number of other bacterial and viral infections could be caused by the bite of non-poisonous snakes.

Mention has been made of only 4 common poisonous snakes in the above descriptions. The following snakes are definitely poisonous but the polyvalent anti-venin noted above neutralises their venoms; – King Cobra, Coral snake, Sea–snake, Bamboo Pit-viper, Himalayan Pit–viper and Banded Krait.

Snake Food and Feeding

Snakes normally prefer live animals for food. In laboratory trials it was noted that poisonous snakes preferred a mammal to an amphibia, i.e., a mouse to a frog.[1] In these experiments it was also indicated that the calcium content of the mammal blood was nearly half of that of amphibia and reptiles. A frog of the same weight took more time to die than a mouse when equal doses of cobra venom were injected. A poisonous snake strikes the victim and withdraws to avoid retaliation and keeps hovering round until the animal is dead. The snake will then move by the scent towards the head of the victim. After testing heat and other sensations, the snake swallows the head of the mouse, the teeth acting as propellers. The entire

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[1]I. C.M.R. Reports, 1953-56.

mouse of about 20 gm in weight is engulfed in three to four minutes. One can see the mouse going beyond the neck region along with the pushing and peristaltic motions of the digestive tract. After the meal, the snake raises its head, opens its mouth and then closes it, settles down for rest and digestion. The venom acts as a paralysing agent and also helps digestion of the tissues of the victim. These and other digestive juices are responsible for the digestion. They can digest anything except nails and feathers. Snake poison contains proteases, oxidases and other enzymes that help in disintegrating and digesting the tissues. Once having fed, the snake does not require food for some days.

The snake may sip some milk, but this is primarily as a liquid in lieu of water. No snake can live on milk alone.

Amongst non-poisonous snakes, the python opens its mouth and from a coiled condition hurls itself at the victim, the mouth is closed round the victim and instantly the huge body coils round the victim and exerts a pressure. A 200 gm rat when so attacked is asphyxiated within three minutes. One can see the lips of the rat turning blue gradually. The snake keeps the coil till the animal is dead and then eats it from the mouth end. A well developed python can thus kill a dog and a deer too. After this the snake will go for rest and later twine round a tree probably to crush the bones of the victim. A Boa constrictor can hold even a panther or a stag in this state and kill it. The jaws of a snake are not ankolysed and it can open its mouth upto an angle of 180°. Similarly the mandibles are united in front by an elastic ligament. The forked tongue protrudes even when the mouth is closed. The victim is pressed in by the incurved teeth on the mandibles which prevent the escape of the bolus. If the victim is broad, the animal presses it lengthwise, just as a thick pack of coffee is pressed lengthwise and stored inside a long tin. A rat snake not only coils round the victim but ties a bowline scout knot (*Plate 23*) by its tail end so that the coils remain tight. It also secretes some liquid giving a foul odour.

A King Cobra is noted for feeding on other snakes. So also the banded krait *Bungarus fasciatus*. In fact in some of the villages of Madhya Pradesh, particularly in Chattisgarh Division, the farmers do not disturb this snake, locally known as

"Ahiraj", because it destroys other snakes and does not harm human beings or cattle. Cannibalism is quite common in snakes. I have seen Russell's viper eating its own young ones and two young vipers swallowing each other to death (*Plate 42*). In a survey of Ratnagiri District in Maharashtra, it was noted that the gut contents of *Echis carinatus* snakes predominated with parts of insect body, particularly earwigs.[1] It was possible to rear these snakes on earwigs and other insects. The gut contents also showed scorpions, millipedes, smaller snakes, frogs, lizards and young mice. Lastly, snakes have been seen to go on fast, many a time in captivity. I have seen a rat snake not taking any food for six months and a python for eight months. It took quite an amount of coaxing to feed them after this fast.

Jewels

There is a belief in many places that some snakes have jewels on their heads which illuminate the place when snakes go out in search of a prey. I have seen some "jewels", said to have been recovered from snakes. They were not giving any light. The jewels were supposed to neutralise snake venom and suck out the poison. None of these properties were seen by us. At best the so-called jewels that we received were some tissues that had been kept well polished and preserved in coloured turmeric or *kumkum* probably to keep it dry (*Plate 24*).

The Ear

Snakes do not have an external ear opening like mammals. Nor do they have ear cavity, eustachian tube or a definite tympanum. Except for the eyes, mouth, nasal opening and a pit in certain cases, there is no other opening on the head.

The actual auditory apparatus consists, as in a cobra, of a small semicartilaginous bone called columella auris, which in fact corresponds to the stapes in mammals. This is seen similarly in *Echis* (*Fig. 4-E*). In this primitive condition, i.e., the absence of the proper internal auditory apparatus of

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[1]Deoras and Vad (1961).

external ear, it is believed that snakes cannot hear. Snakes, on the contrary, are very sensitive to the minutest tremors received through the ground or any other substartum. In our experiments with a cobra inside a tin box, it was noticed that playing of fine mild tunes of music near the tins had no effect on the snake. On the contrary, any blaring sound that impinged heavily on the tin, made the cobra raise its hood. Similarly, soft music played near the snake basket had little effect. One snake charmer was taken inside our snake farm and made to play his routine gourd music which is supposed to attract snakes. There was no response and no snake came out. It was only when he blared the gourd music on the dealwood substratum that the cobra inside raised its hood. Similarly, merely playing gourd music did not make the cobra sway its hood. It was when the charmer shook his flute and hand that the cobra swayed with specific purpose of getting an aim to attack and tried to strike once or twice. It thus seems that the cobra sways to the swaying of the hands and the movement of the flute (*Plate 2*).

The stapes is connected to the quadrate bone of the skull in the Indian cobra. It is likely that sound waves impinging on the substratum may be perceived by the lower jaw as vibrations and transmitted. The question then arises as to whether the cobra can further preceive the vibrations once it has raised the hood. In our experiments we found that once the hood had been raised, the snake was more sensitive to movements rather than to sound waves. Tumarkin also mentions in his theory that snakes perceive sound as substratum vibrations.[1] Bellairs and Underwood give similar views.[2] In India, in the rural areas, it is a practice that villagers, while moving at night, carry split bamboo sticks and go on making a noise which conveys the vibrations on the ground and the approaching sound warns the snake which may probably move away. It is quite likely that wooden sandals and even tinkling bells on legs and on the cattle's neck may give out such warning vibrations of approach which may cause the snake to move away.

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[1]Turmarkin (1955).
[2]Bellairs and Underwood (1950)

The Forked Tongue

The tongue of a snake is forked. It is delicate and it often sticks out of the mouth even when the latter is kept closed. As has been mentioned before, the lower jaw of a snake is not a complete bone. In front, it is joined by a cartilage leaving some space in the centre. Through this the tongue often sticks out. The tongue is not used as an organ helping the intake of food. It is primarily an organ of sense. When a snake is lying still, well hidden in the surroundings, when the eyes without the eyelids also remain still, it is only the movement of the tongue that gives out the presence of a snake. The reptile using the tongue tries to find out whether there is any danger in the vicinity before moving ahead. The tongue consists of two cylindrical finely tipped organs joined at the base. They are so situated that they can stick out even when the snake is taking in its prey. The organ is variously coloured in different snakes, but it is primarily an organ helping the olfactory senses. When an *Echis carinatus* moves, the tongue is stuck out tips apart. If there is any danger the frequency of the movement of the tongue is very quick. In fact at such times it looks as if the snake is spitting. In the initial movements the two arms are kept apart sideways, but later they come nearer. The frequency of sticking out a tongue is reduced markedly as the snake is about to strike. In the case of a cobra also the flickering of the tongue is very active before raising the hood and when the hood is about to come down. But when the snake is agitated and stands erect to strike, the frequency of movement is markedly reduced.

It is believed that the tongue collects scent particles from the air and while the tongue is withdrawn, transfers them to a structure called Jacobson's organ for perception. This organ is situated on the palate of the upper jaw. A cobra may smell the approach of a mouse by its movement. Snakes breathe less frequently than warm blooded animals. The approach of the mammal scent and its movement have to be properly perceived. The tongue then quivers, comes out, spreads wide apart, collects the scent particles and goes on transferring them quickly to the Jacobson's organ for quick perception. The tongue, therefore, helps the sense of this smell perception to the normal organ, i.e., nose.

The tongue helps the snake in getting its food and its mate, besides helping in locating its enemies.

Eyes

The eyes of snakes have no eye lids. As the eyes have no eyelids, they look open all the time. There are legends built up that the snakes hear by eyes and the Sanskrit word *chukshushrawa* (one that hears by eyes) has been coined for this purpose. When the snake is on skin, the eyes are seen to be covered with an opaque covering. At such periods, the snake is not able to see things. Once the skin has been cast off, the snake regains normal sight.

The eyes of the snake have a round or elliptical pupil. Those snakes that move in the daytime or see during daytime normally have an elliptical pupil. Noctural snakes have a round pupil. The pupils are capable of slight adjustment by construction or expansion. Wall mentions that snakes "do not have a retinal centre of high sensitivity, hence there is no fixation or precise aiming of the eye at objects. In most snakes, the eye sockets are so far back on the sides of the head that the range of possible stereoscopic vision is limited to a very narrow field directly in front of the snake".[1] The snake's eyes have the capacity to narrow the pupils in the face of a strong light. When a snake is supposed to be resting or sleeping, it more or less closes the iris to the minimum, leaving only a thin opening of the pupil. When disturbed by a beam of light focussed on the eye, this opening widens.

The eye-balls have a small range of horizontal rotation. The two eye-balls can rotate independently. The snake's eye also has a hard transparent lens-like covering called brille, which is a valuable protection to the eye and may have some optical effects. This brille or spectacles is shed periodically.

A difference is seen in the cells of the retina of a diurnal and other snakes. It pertains to the suppression of single or double cones in favour of rods. There are different colour pigments also in this region. The iris colour in many snakes more or less matches with the surrounding colour pattern of the head of that particular snake.

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[1]Wall (1942).

Wall mentions eye-shine in some snakes like some kind of phosphorescence.[1] But many workers think that this is only a reflection of the spectacle. It is doubtful whether the snake appreciates different colour patterns.

Experiments carried out have revealed that a cobra during day time made six attempts at an inch thick stick held only two feet from its head. These attempts were made more frequently when the stick was slowly moved and the snake wanted to take an aim. On the stationary stick the snake did not strike, unless other objects moved or something disturbed it. These experiments give an answer to the phenomenon of swaying its head to the gourd piper, only when the gourd is moved or the charmer makes some movement.

Snakes therefore get only a general impression of the habitat and they may not get a proper sharp image of any definite object.[2]

Touch

Even though snakes have no appendages and despite the fact that they are covered by scales, they are very sensitive to a minute tremor or contact. A slight touch by a fine string or a few particles of soil falling on the body brings the snake to alertness. It has also been observed that they discriminate these sensations and translate them into actions for aggression or protection. A cobra if properly handled does not seem to strike. I have noted that a gentle and slight touch in a careful way does not arouse a cobra, while trembling fingers and a squeezing touch immediately makes it react aggressively.

Revenge

Several snakes give out some odoriferous secretions. A rat snake (*Ptyas mucosus*) emits a fairly foul smell and on touching this snake, this smell is often left behind on the hand. A krait (*Bungarus caeruleus*) emits a black secretion from the anal glands during certain months. This secretion has some odour. A large number of female snakes secrete

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[1]Wall (1938).
[2]Klauber (1956, p. 359).

glandular discharges from the post-anal glands. The male snakes seem to be attracted during certain months to the females, probably due to this smell. It is surmised that a snake can follow the smell by its quivering tongue from a distance to the object. There is therefore some fictitious truth that a snake can follow a human being to take revenge. It may probably be due to some smell emanating from the human body. But how far it can follow and on what surface is doubtful. The belief that a snake has taken revenge may be baseless. However, Meek (1946) mentions an incident in which a diamond-back viper had no difficulty in selecting for attack, from a ring of men surrounding it, the particular individual who had traitorously divulged its hiding place to another.[1]

Among Indian snakes the cobra seems to be more intelligent than the python. A snake in the laboratory has been able to react to material that brings food. A snake in nature has been seen to react by concealment or to exhibit aggressiveness to an intruder. A snake accustomed to a charmer who feeds it, reacts differently to others. Like other animals, it is careful regarding strangers and reacts by hiding or by a violent mode of action or by adopting other definite tactics. Gentle handling or quivering hands make the snake perceive the difference for the appropriate reaction. However, it may clearly be stated here that the same method of handling makes the snake react appropriately. It is only in such cases that handlers get bitten due to some small lapses in their own behaviour and handling pattern. It is for this reason that handling should be restricted or done with proper protection. I have personally seen cobra snakes with fangs intact, being carefully handled. Some snakes have been put round the neck of the late Jawaharlal Nehru by Shri Pachalegaonkar Maharaj[2] (*Plate 25*).

The pit in vipers

In the green bamboo pit viper, there is a depression on the loreal scale near the nasal opening. This pit is found in a

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[1]Meek (1946).

[2]A photograph showing late Nehru with a Krait round his neck appears opposite page 104 in the book *Bharatiya Samasthi Dharma*.

number of snakes belonging to the family viperidae. In pythons also, there are small pits on the upper lips. The famous experiments of Nobel and Schmidt have shown that these are thermoreceptors.[1] Any variation in temperature is perceived by this organ in the pit (*Plate 26*)

The morphology and anatomy of a typical viperine snake, *Echis carinatus* has been worked out by Deoras and Vad.[2] Some systems from these are given below.

The Digestive System (Fig. 5)

The mouth cavity in *Echis carinatus* is bounded by the upper jaw and the lower jaw. On the palate, internal nares open anteriorly. Behind this is a small depression accommodating the glottis. By the sides of the nares are the fangs covered by fleshy sheaths. Between these are the palatine teeth. Below these are pterygoid teeth. The retractile bifid tongue lies in a sheath in the middle of the mouth. It is supported by an hyoid apparatus having an elongated cartilaginous arm.

The poison glands lie one on either side of the upper jaw below the orbit. Anteriorly it narrows to form the poison duct. At the anterior end it forms an ampulla-like structure before opening at the base of the fangs. The fangs are backwardly directed maxillary teeth. A longitudinal section of a fang shows a hollow tube and at the base of this tube open the ducts of venom glands.

The buccal cavity led to the pharynx which is shorter and a little broader than the oesophagus. The entire alimentary canal from here onwards lies to the left hand side of the body cavity. The oesophagus is thin walled and runs into the dilated stomach which is also thin walled and has internal longitudinal muscular ridges. The distal portion of the stomach is narrower and is marked by the pyloric valve having transverse muscular bands. After the pyloric valve lies the intestine, the upper portion of which forms a duodenum, where the pancreatic and cystic ducts open. The first portion is the small intestine which is coiled and the posterior portion is straight which finally leads into a dilated rectum. The rectum often contains

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[1]Nobel and Schmidt (1937).
[2]Deoras and Vad (1961).

undigested food and opens into a cloaca which is covered by an anal plate. Excreta when semi-solid looks grey and partly black.

Liver is formed of two unequal lobes on the right hand side of the digestive tract. It starts behind the heart and ends a little ahead of the gall bladder. The right lobe is longer than the left. It is red in colour and smooth in appearance. The gall bladder is greenish and is attached to the liver near the pyloric end of the stomach. The cystic ducts and the bile ducts commonly unite with the pancreatic mass and ultimately open into the duodenum.

The following are the averages of some of the measurements :

Oesophagus	11.0 cms
Stomach	7.3 cms
Rectum	2.5 cms
Left lobe of liver	6.5 cms
Right lobe of liver	18.0 cms
Pancreas	0.5 cms
Pharynx	10.0 cms
Coiled intestine	12.3 cms
Gall bladder	1.0 cm

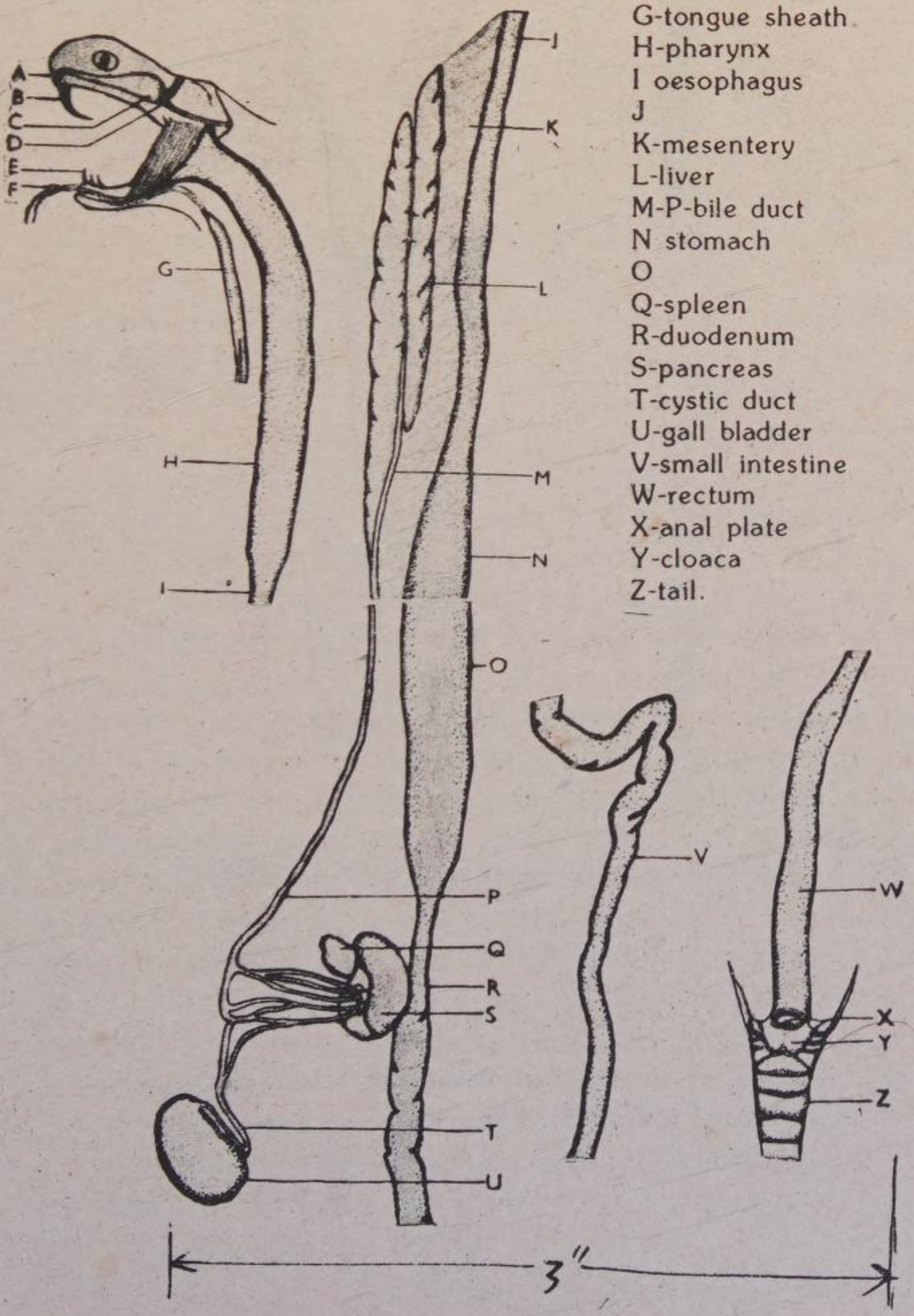
Respiratory System (Fig. 6)

The respiratory system consists of a tracheal tube leading into a solitary lung. In the case of this snake the left lobe of the lung is more or less absent. The right lobe, therefore, consists of two portions, the anterior vascular and the posterior saccular. The vascular part is spongy and extends upto the heart. The saccular part is reticulate and extends upto the kidney, acting as a reservoir of air. No wonder the viper seems to swell as it gets agitated and this saccular part leading upto the kidney gets heavily inflated.

Air is taken in by the external nasal opening which leads upto the glottis, below the tongue. It leads to the muscular and cartilaginous tracheal tubes which later merge with the vascular portion of the lungs. Near the glottis the tracheal portion has heavy layers of muscles and this portion is often called a larynx. In some snakes, particularly *Ptyas mucosus*, one does find some kind of a guttural sound emanating from this region.

Fig. 5 Digestive-system of
Echis carinatus.

A- duct of poison gland
B-fangs
C-poison gland
D-muscle controlling the gland
E-teeth of lower jaw
F-bifted tongue
G-tongue sheath
H-pharynx
I oesophagus
J
K-mesentery
L-liver
M-P-bile duct
N stomach
O
Q-spleen
R-duodenum
S-pancreas
T-cystic duct
U-gall bladder
V-small intestine
W-rectum
X-anal plate
Y-cloaca
Z-tail.



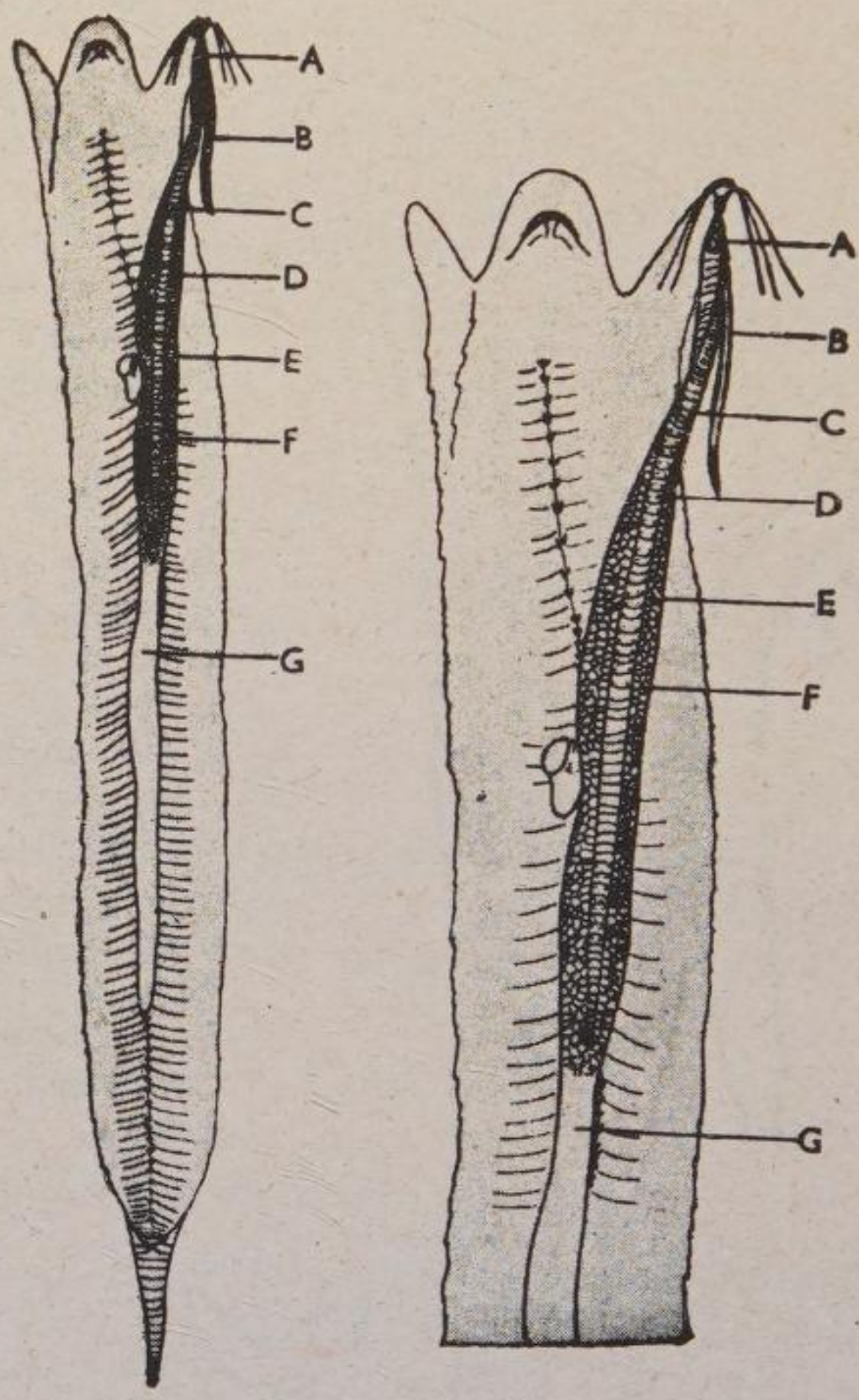


Fig 6 Respiratory system of Echis carinatus.

A–Glottis
B–Tongue sheath
C–Tracheal
D–Tracheal rings
E–Vascular lung
F–Reticulation of vascular lung
G–Saccular lung

The following are some of the measurements :.

Trachea	12.7 cms
Vascular lung	7.0 cms
Tracheal tube	3.5 cms
Saccular lung	17.0 cms

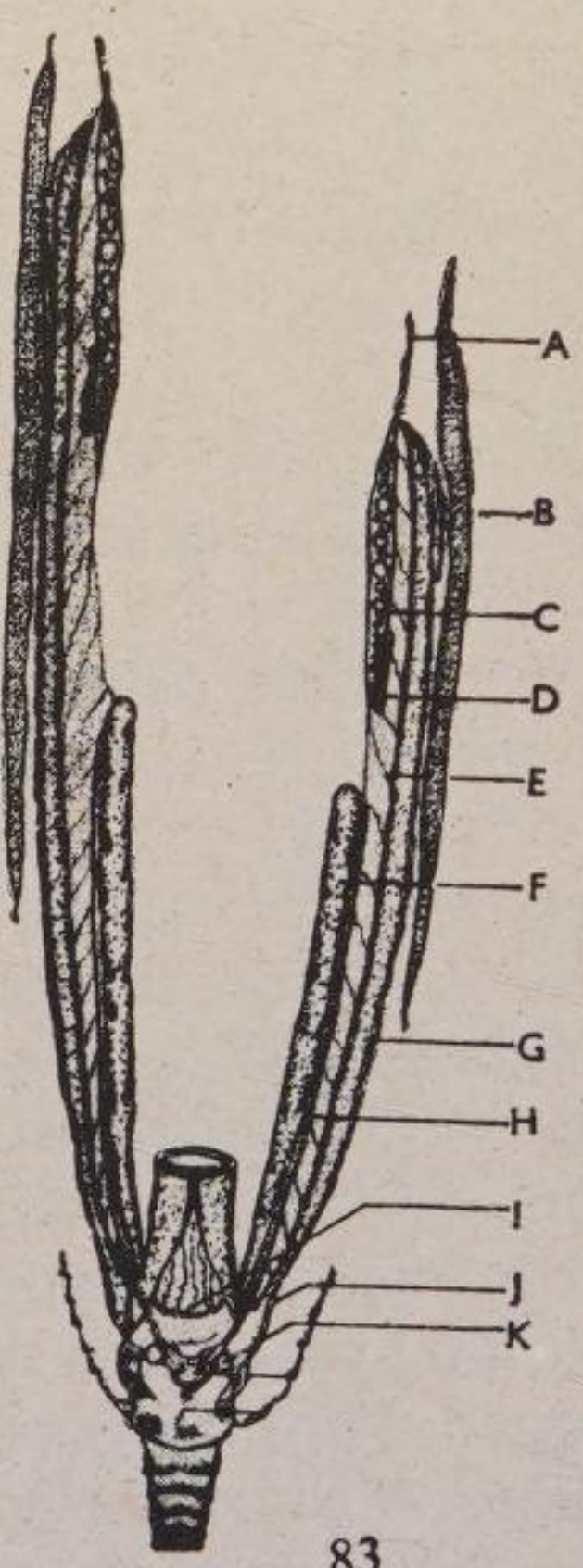
A non-poisonous snake like the python has two distinct lung lobes.

Urinogenital System (Fig. 7) – (Reproductive and Excretory)

The kidney is narrow, strip-like and has a slight constriction. It is attached to the body wall dorsally by the folds of the peritoneum. From the outer sides, a white delicate duct of ureter runs down posteriorly into the cloaca. Urinary bladder as a separate unit is absent.

In *Echis* snakes, sexes are separate. In males, the testes are yellow oblong bodies, the right lobe lying a little above the left. Each testis is attached to the body wall by a fold of the peritoneum. Adrenals are attached to the lower margins of the testes. Vas deferens starts from the anterior border of the testes and runs on the dorsal side to form the coiled epedidymis. This is followed by the sperm duct that runs along the ureter to the common opening in the cloaca. Thus, two openings at either side are situated in the cloaca. A small raised surface forming a papilla is situated at the openings of the cloaca. A pair of reversible copulatory organs–penis is present in the tail of the animal. Sex can be determined by pressing the tail from the tip towards the cloacal opening. In the case of males, two stumpy organs–penis, project out from either side of the lobes. These stumpy organs have longitudinal furrows (*Plate 27*) and transverse rings. Sperms are carried through these furrows at the time of the ejaculation and are taken to the tip of the lobes of the penis and along the canals on the ventral side and are deposited in the cloaca of the female during copulation. Tips of the lobes are round and blunt. Spine-like structures are present at the side of the penis.

In females, the ovaries are elongated bodies with a ridged surface and rounded elevations showing the presence of ova. Ovaries are situated at the same level as the testes in the males. The right side ovary is a little anterior to the left.



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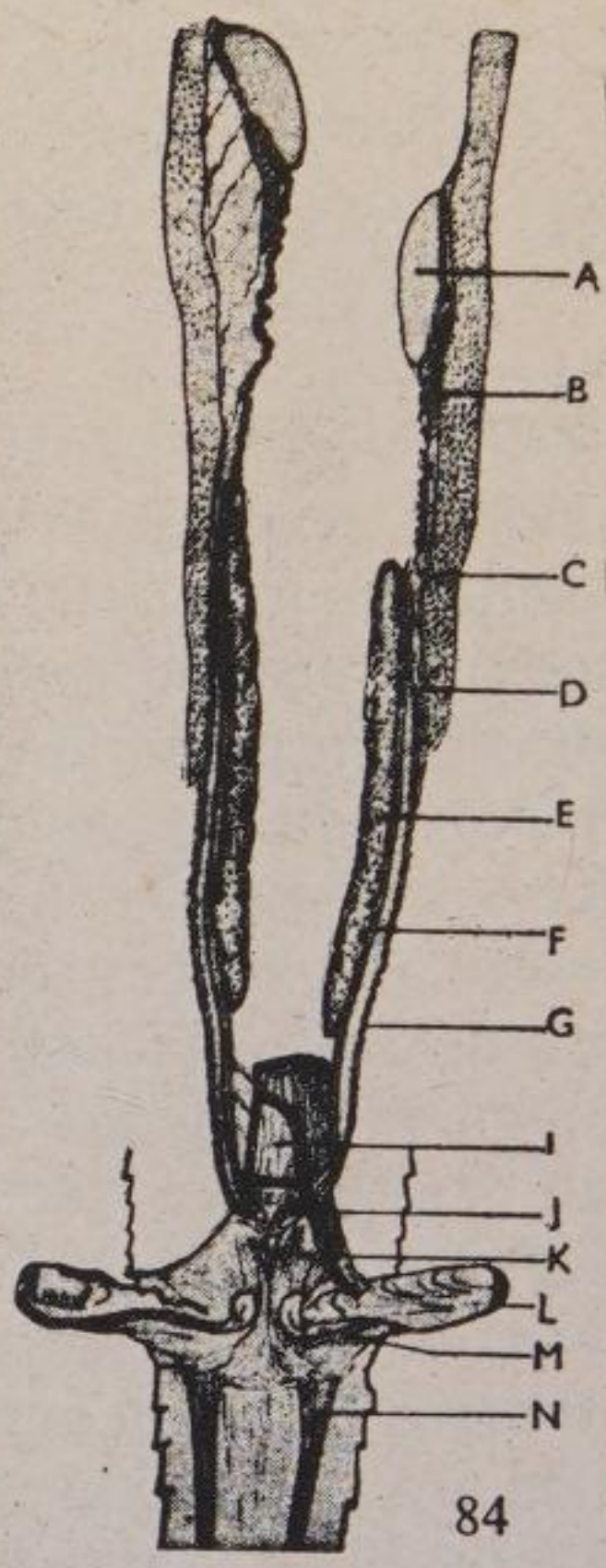

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Fig 7 Reproductive system of *Echis carinatus* (Urinogenital).

83-Female	**84-Male**
A–Ligament	A–Testis
B–Fat body	B–Adrenal
C–Ovary	C–Fat bodies
D–Adrenal	D–Vas deferens
E–Mesentary	E–Kidney
F–Kidney	F–Ureter
G–Oviduct	G–Vas deferens
H–Ureter	I–Rectum
	J–Urinogenital opening
	K–Cloacal muscles
	L–Penis
	M–Groove in Penis
	N–Penis muscles

Ovaries are also attached to the body wall by the folds of the peritoneum. Adrenals are attached to the lower outer margins of each of the ovary. The oviducts are thin walled ducts, opening anteriorly at the level of the ovary by a funnel like opening. Oviducts dilate posteriorly to serve as a pouch for the developing embryos. The ureter and the uterine openings are separate representing four openings in the cloaca, instead of two openings as in the case of the males.

The viper produces from 40 to 75 young ones in about three days. On hatching, the young ones move out and cast their skin on the second day. They do not feed for about 15 days, but later migrate for food. The eggs in other snakes are laid in soil and in some snakes like the King Cobra a nest of bamboo leaves is made and the female sits over the eggs. Pairing normally takes place in the rainy season. This is always done in a horizontal position. Eggs are laid in the following spring from March to April. In the case of a cobra, it was seen that the egg took about 58 days to hatch and the snake had laid about 55 eggs. As has been mentioned before, some snakes lay eggs and others lay young ones. *Plate 29* shows a fowl egg along with a rat snake, Krait and cobra eggs and the embryo of a Russell's viper. The eggs are blunt at the tips.

There is a distinct difference in sizes between the male and the female snakes. Either of them may be longer. But it is invariably seen that the tail in males is always longer than that in the females. Secondly, to confirm the sex, if one were to rub and thumb from the tip of tail upwards, two projections of penis will stick out from the vent opening in the case of all male snakes. There are no projections coming out in female snakes. There is a short phenomenon of maternal care when a cobra snake sits over the eggs.

Circulatory System (Fig. 8)

The heart in snakes consists of three chambers, two auricles, and a ventricle. The ventricle has a small septum indicating the onset of its division in future evolution. The blood coming from the lungs duly aerated, and the blood coming from the body for aeration get partly mixed up in the ventricle.

In a comparative study done on the blood of some snakes and mammals by us it has been observed that a cobra weighing about 1031 gm has about 25 cc of blood, the haemoglobin content being about 8 gm to 10 gm, and the calcium content was 17 to 20.5 gm for 100 cc of blood serum. The value for a rabbit weighing 1670 gm, was 50 cc of total blood, 12 to 16.2 gm haemoglobin and 10 to 50 gm of calcium per 100 cc of serum.

The blood circulation has been modified due to the compressed nature of the body, the absence of limbs and the reduction of one lung, especially in poisonous snakes. The blood vessels to the limbs have been aborted, and the carotid, and jugular have become asymmetrical.

Nervous System (Fig. 9)

This consists of two lobes of cerebral hemispheres which in front carry two small olfactory bodies. These lobes send olfactory nerves anteriorly for the perception of sensations allied to smell. Ventrally optic nerves emerge from the posterior basal region of the cerebral hemispheres and supply the eyes. The cerebellum is a triangular region behind the hemispheres. On the ventral side lies the pineal and ahead of it the pituitary body. The posterior part of the brain consists of the medulla oblongata which is continued into the spinal cord. The body temperature of the snakes is more or less in keeping with the temperature of their surroundings (98°F). They go in for hibernation in winter months and wake up at the onset of spring.

A snake that is exposed to cold gets frozen. A cobra when exposed to the hot sun even for one hour dies. *Echis carinatus* on the contrary can stand the heat of the rock and sand better.

Movement

Swimming: All snakes can swim. But the capacity to swim for longer periods and stay long in water is confined to water snakes. The body of these snakes is modified in a way that the ventral scales are reduced in size and the tail is flattened to form a structure like an oar (*Plate 30-b*). I have seen snakes dipping inside ponds and remaining submerged for about ten minutes without coming up for respiration.

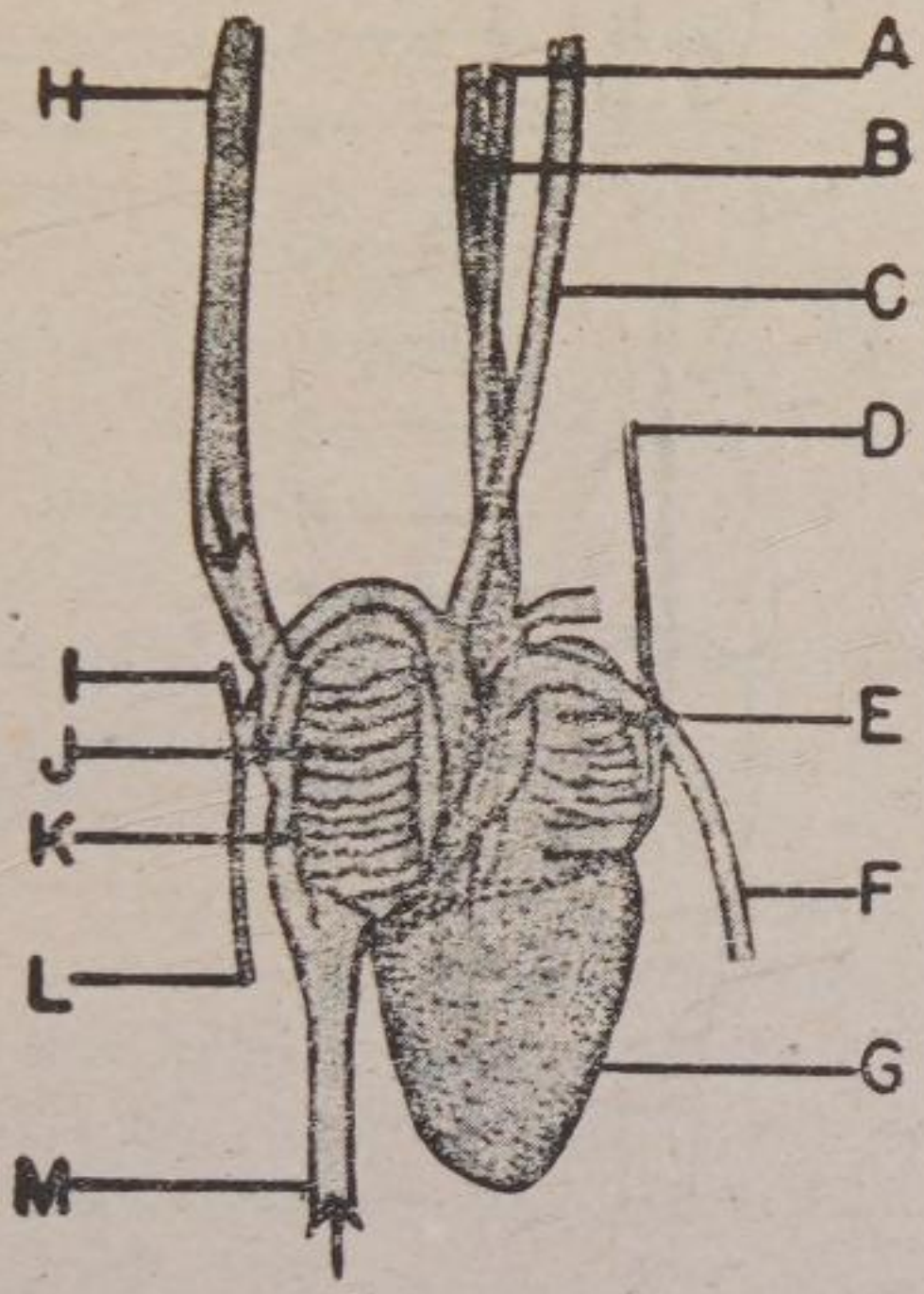

Fig 8 The heart and the circulatory system of *Echis carinatus*.

A–Pulmonary artery
B–Pulmonary vein
C–Carotid artery
D–Right precaval vein
E–Right auricle
F–Right systemic
G–Ventricle
H–Left precaval vein
I–Anterior vertebral artery
J–Left auricle
K–Sinus venosus
L–Left systemic
M–Post caval

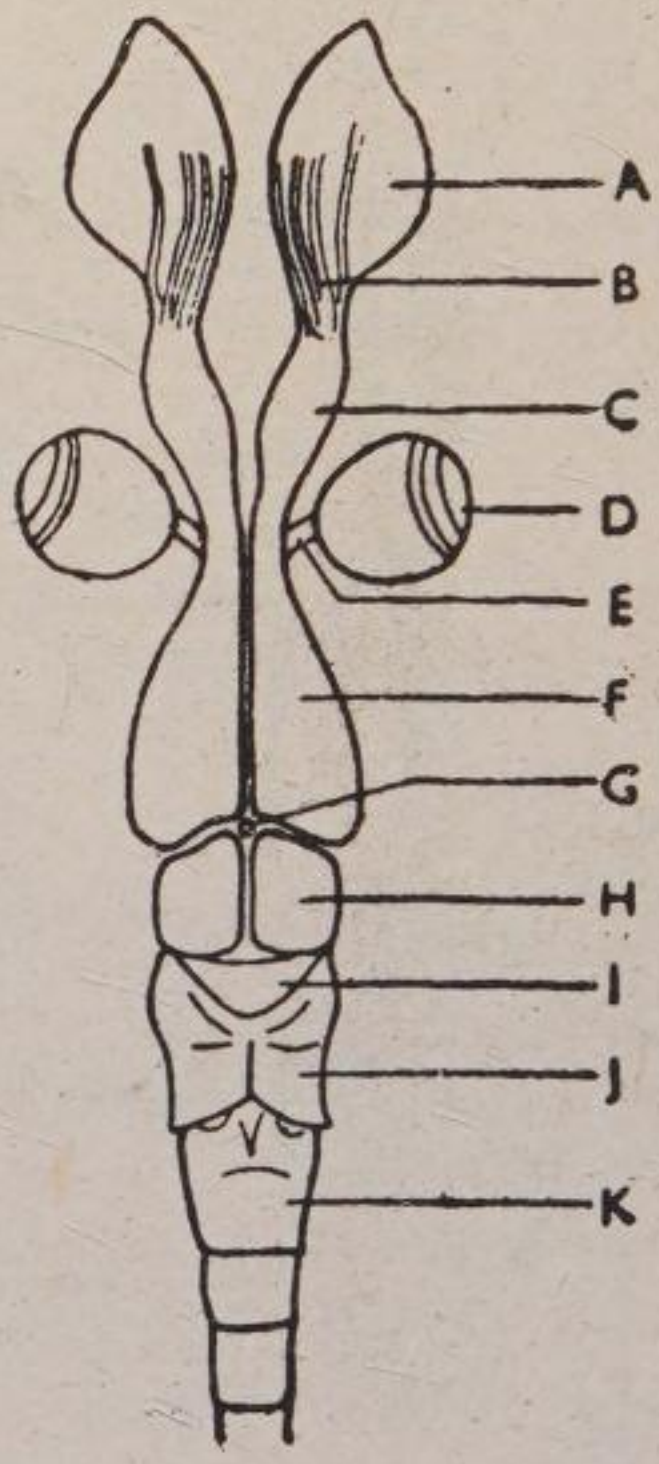

Fig 9 Nervous system of Echis carinatus.

A–Olfactory capsule
B–Olfactory nerve
C–Olfactory lobes
D–Eye
E–Optic nerve
F–Cerebral hemisphere
G–Pineal body
H–Optic lobes
I–Cerebrum
J–Medulla oblongata
K–Spinal cord

Swimming is done by keeping the head, particularly the anterior portion, with the nasal opening above water and the progression is made by the undulating motions by the body.

Climbing: The rat snake (*Ptyas mucosus*) or the green whip snake (*Dryophis nasutus*) or *Chrysopelea ornata* has been seen to climb trees quickly. These seem to be very agile and the climbing is done by the undulatory movements of the body and the forward thrust. The ventral scales probably try to grip the surface along with the tail which goes on twining round the objects. In fact, a rat snake is capable of tying a knot round any vertical object and exert a pull (*Plate 23*).

Crawling: The movement on land is brought about by four roughly defined techniques.

(1) Horizontal Undulatory Progression

This can be compared to the lashing of the body from side to side in a longitudinal motion. This motion may be brought about in a series of side waves gliding smoothly along, and each part of the body definitely following the wavy path first taken by the head and the neck. The straightening and shrinking of the body at the spots where the curvature decreases and increases is brought about by the musculature inside the body. This increase and decrease in the curvature at spots where snake encounters resistance may be compared to a pivot for the curve. This method of progression is normally met with on rough surfaces negotiated by the snakes.

(2) Rectilinear Progression

This method of progress is more useful for the thick bulky bodied snakes like boas and vipers. In this method the ventrals are pressed against a hard surface and the body is slid forward within the skin, pulled by the appropriate muscles. As the inside body goes forward the ventrals loose the hold and take the hold further on, and this process continues from neck to tail. The points of contact in the length would be many, but the motion is like a wave and is more intense in the middle of the body. The direction of movement is in a straight line though the undulations are sideways. The snake can adopt this method to go back and forward.

(3) Side Winding

This method of progression is seen more in snakes having the ecological conditions of a sandy desert. In India *Echis carinatus* shows this method of motion. It is also adopted to some extent by snakes negotiating a smooth surface. Here the head and the neck get an anchor on the substratum. Often the head remains partly raised and poised for a strike. However, as the head and the neck are anchored, the body moves forward at a 30 degree angle from the line of progression of the head. The head then moves to the other point of anchor at the other side and the body again moves at a 30 degree angle. Thus the body is partly moved in advance of the anchorage. There are no transverse but only vertical forces that are applied to the track, covering the same length as that of the snake.

Human foot without shoes can negotiate better than with shoes in desert sand by taking an anchorage or grip and then putting forward the next step for another grip, so does an *Echis carinatus* snake negotiate in loose sand for progression. The method is called side winding, because if a line is drawn from head to tail, the axis of progression would be perpendicular to this line in the shape of the letter 'S'.

This method is used when the surface is smooth or when the snake is taking a slow hesitating motion while stalking a victim. The speed attained by this motion is about two miles per hour.

(4) Concertina Progression

Some scientists call it an earthworm type of movement. In this method, the central part of the body is gathered into a couple of curves and then they are straightened. While this is being done, the head is anchored so that the tail end comes nearer and forward. The process is repeated as curves are formed and the tail is anchored so that the head and neck are thrust forward. With each complete cycle the snake advances by the difference between the lengths of the snake.

This method may not be the normal motion in snakes, but is adopted when the snake is in hiding and is investigating an object slowly. The method also gives the snake a chance to hide itself in the natural surroundings due to its camouflaged

skin, as part of its body always remains stationary. As it is not subject to a lateral motion, the head can concentrate on any object for a strike. Lastly, on a smooth surface and with restriction of side walls this method may be useful as compared to the rectilinear progression.

Speed : The side winder has been seen to do about two miles an hour and probably covers about 1,000 yards in a night prowling. Dr. Klauber quotes Hastings to mention that the speed of an African mamba may come to about 30 miles an hour.[1] This is doubtful. The snakes are cold-blooded animals. They do not have a cooling system like the sebaceous glands of mammals wherein they could sweat out. The snake may sit in the sun to pick up heat or hide in cool places to reduce the body temperature. The heart is also three chambered, so that the aeration of the blood may not take place in a proper manner. The body temperatures are also low. Considering these factors, it is likely that a snake may attain a speed for some very short periods in the form of darting, but it may not be in a position to keep it up.

The speed of Indian snakes has not been worked out.

Longevity

Reptiles normally live long. The tortoises are known to have lived for 500 years. In the case of snakes, laboratory experiments have shown them to live for a period of six years so far. In nature they may live at least five times more than this. No authentic records are available to know the longevity in the case of Indian snakes, except those in folklore and stories.

Rearing

Snakes cannot stand very high or very low temperatures. Normally they do not want to be in bright sunlight or under any glaring light. Except for certain species like *Echis*, a majority of snakes prefer tolerable amount of humidity. Lastly, snakes need peace and quietness.

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[1]Dr. Klauber (1956, p. 348).

If these conditions are given it is possible to rear snakes. There should be clean cool water in the area for drinking and some living food be given to it twice a week. The food may consist of small mice, frogs, or lizards. In the case of python, a rabbit, pigeon or a fowl is needed per fortnight while the very small snakes like *Echis* could be fed with insects. A number of snakes could be handled with ease and fed with minced meat to which has been added a dilute solution of Vitamin B Complex. If milk is to be given, it be made into a flip by adding an egg and the liquid poured into the mouth by a funnel. Care should be taken to prevent the funnel stem from hurting the oesophagus.

The snakes that could be reared as pets without harm are a few of the following:

Natrix stolata, Typhlops braminus, Eryx johnii, Pythom molurus and *Ptyas mucosus.*

The cage should be such as to keep the excreta away from the resting area of the snake. Some dilute anthelmintic drugs given once in three months will keep the snakes free from worms. The major ailments to be avoided are mouth infection and partial casting of skin.

The description and running of a snake farm are given by Deoras.[1]

Snakes could be easily handled. Snakes like the Cobra, i.e., those with grooved fangs, are lifted by the tail, keeping the head away. The head is then pinned, caught between the thumb and the index finger, and the snake is thus held with the tail in the other hand. The big fanged Russell's viper is pinned at the head, caught by the thumb and the index finger and then held up. The snake is released by holding it in a bunch and very quickly throwing the lot in the cage and simultaneously closing the door of the cage. The snakes are handled for milking the venom or for sexing. However, the former could be done in special cages since this requires very little or no handling. Medical aid, and antivenin kit must be kept ready whenever, and wherever snakes are handled. The snake population in India is declining, as such, proliferation of snake farms and shows, should be avoided as the snakes do not survive long in captivity.

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[1]Deoras (1963).

CHAPTER IV

CLASSIFICATION AND IDENTIFICATION OF SNAKES

THE broad distinguishing features to help one know a snake are given in Chapter III. In the present chapter are enumerated some simple points to distinguish poisonous snakes from the non-poisonous ones. It also gives a list taken from Smith of the names of different snakes found in India and their probable distribution.[1]

There are about 216 species of snakes recorded in the Indian Union by Smith.[2] Table No. I groups these species into poisonous and non-poisonous snakes. It will thus be noted that there are more non-poisonous snakes.

Indian snakes have been grouped into a number of families. Table No. II (a) and (b) classifies the different families by simple characteristics to enable readers to know a poisonous from a non-poisonous family. Table II (a) gives the characteristics of poisonous snakes. Table II (b) gives the characteristics upto family only. There are a number of snakes under each of these families available in India. Table No. III gives only a list of the different species arranged under each family. There is also an indication of the distribution recorded for these species in India. Thirty-six species from this lot have been taken and some details of these are given in this chapter.

Ecological Distribution

The body of the snake is often modified to suit its habitat.

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[1]Smith (1943).
[2]*Ibid.*

These modifications are particularly noticed in burrowers, swimmers, arboreals and terrestrials. Many snakes could be spotted for identification by these characteristics.

The burrowing snake shuns light. The majority of them, rather all of them, are non-poisonous. These snakes are either blind or have very small eyes and the scales are imbricate or are not well-defined. The tail is rather blunt and sometimes has either a spine or roughness which may be used for burrowing purposes. The colour is dull and they may have spots for camouflage. They live on decaying matter, earthworms, insects, lizards and frogs. To this group belong the blind snakes *Typhlops braminus, Uropeltis ocellatus* and sand boas like *Eryx conicus* and *Eryx johnii.*

The swimmers are characterised by the flattening of the tail to form an oar-like organ. The front part of the head being raised, the nostrils are placed at the very tip for breathing purposes. The ventral scales in sea snakes become completely compressed to form just a ridge (*Plate 30*) at the base, giving the snake more chance for counteracting resistance in the sea. This is more prominent in sea snakes than in fresh water ones. The former are invariably poisonous, while the latter are non-poisonous.

Enhydrina schistosa, a sea-snake and *Chersyderus granulatus,* a fresh water snake, are brightly coloured. The scales on the head and the body are tiny as if divided into a number of parts. These snakes, particularly the sea snakes, are very uncomfortable when left on land and they try to wriggle back with the tide into the sea. Their movement on land is very sluggish and they cannot progress. They feed on frogs, fish and mollusca.

The arboreal snakes have an elongated tail and a supple body. The colouration is in harmony with nature. The head is elongated and well-defined scales are present on the head and body. Their food consists mostly of birds and lizards. These snakes are mostly non-poisonous. The parrot-green whip snake, *Dryophis nasutus,* remains perched on tree branches turning with the tail and keeping the head loosely suspended to imitate green tree-twigs. The rat snake, *Ptyas mucosus,* with its long tail (*Plate 23*) is a good climber. We do not have the famous Mamba snake of Africa in our country.

Plate 25. A snake round the neck of late Jawaharlal Nehru.

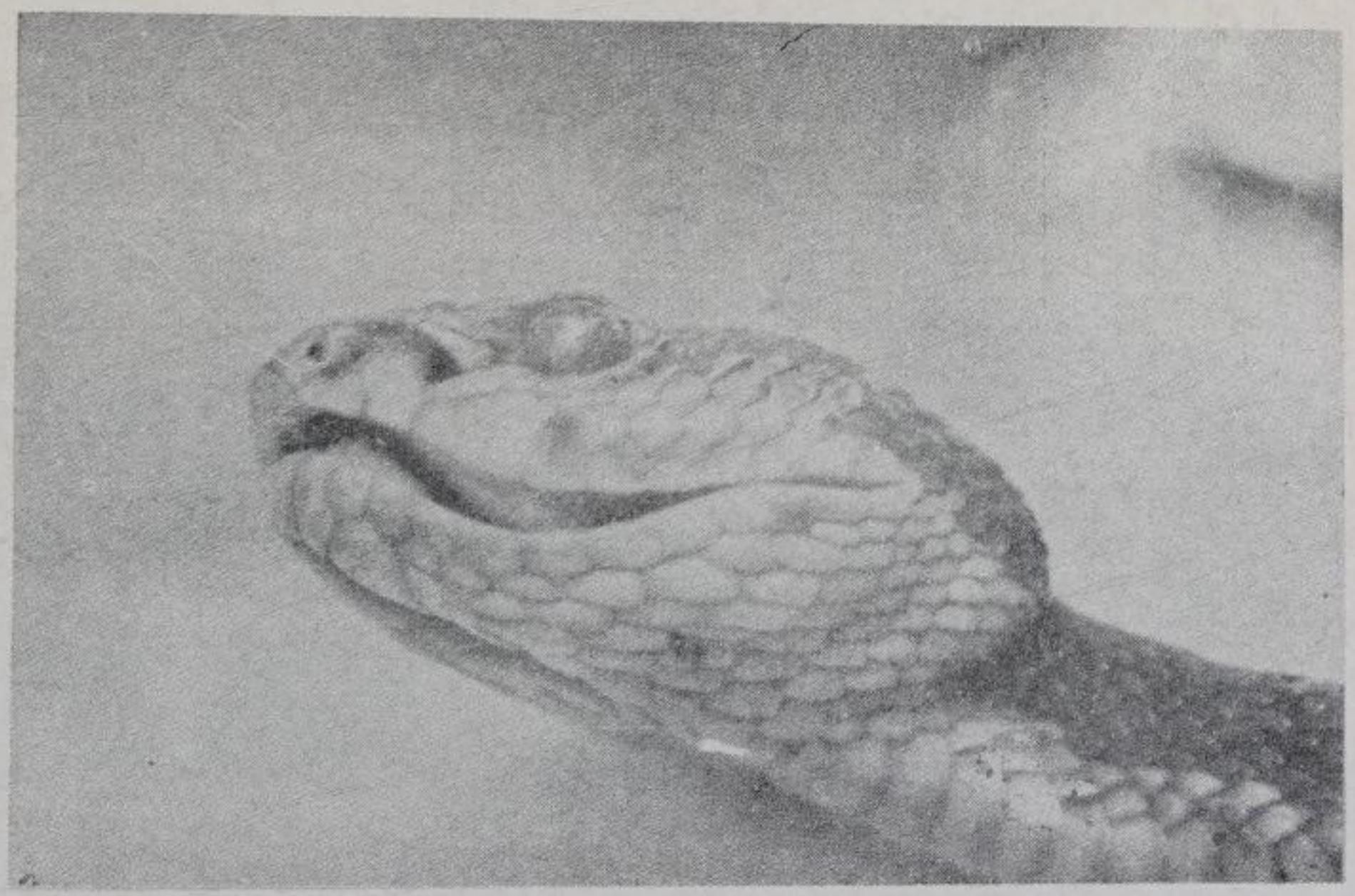
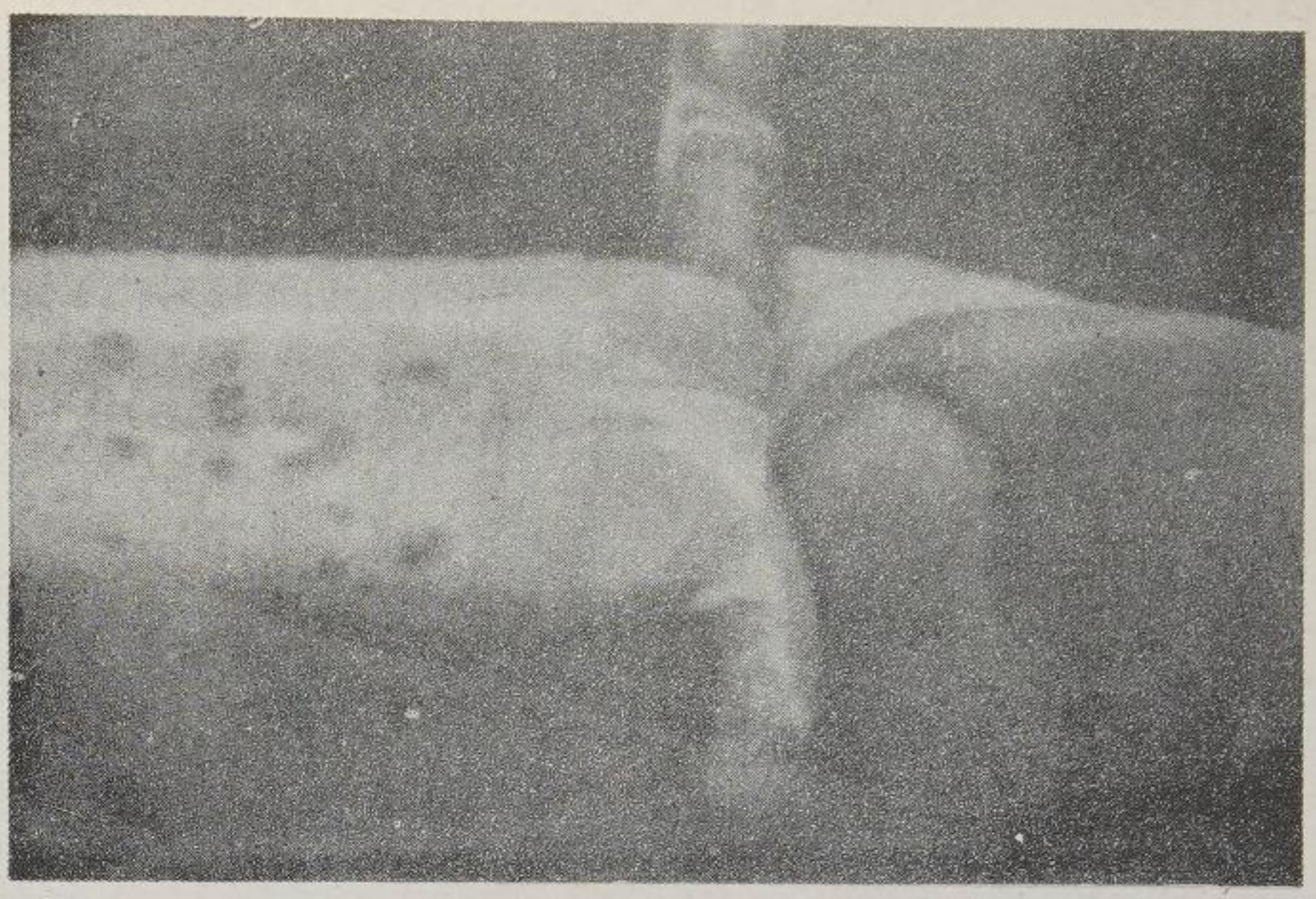


Plate 26. The "pit" in the green pit viper. The structure is at the right of the nasal opening as seen in this figure.



(a)

(b)

Plate 27. Showing penis sticking out, by running a thumb upwards from the tail end.
(a) In a cobra.
(b) Spinous penis of Echis carinatus

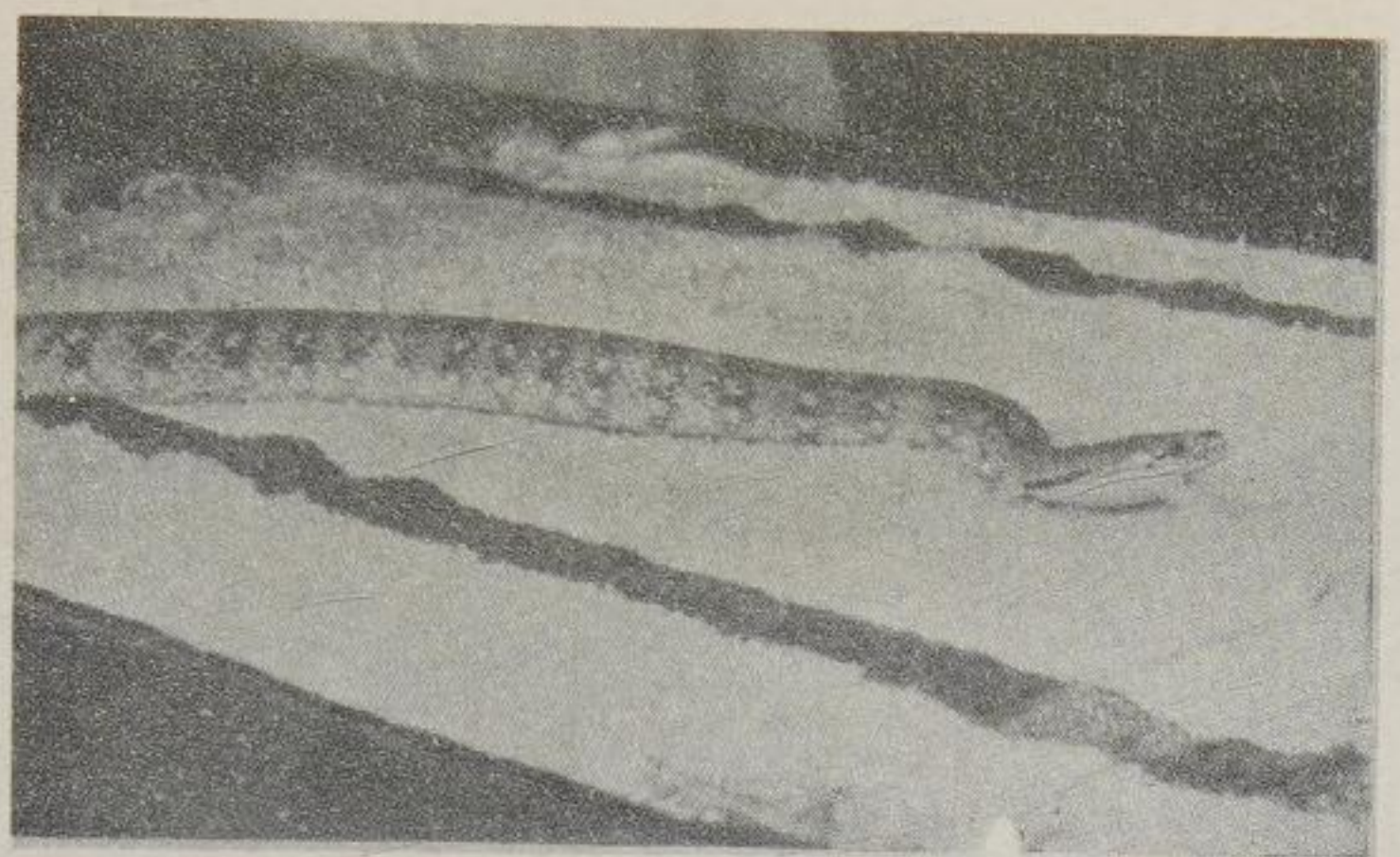


Plate 28. Boiga gokool.
Characteristic pose of head before striking.

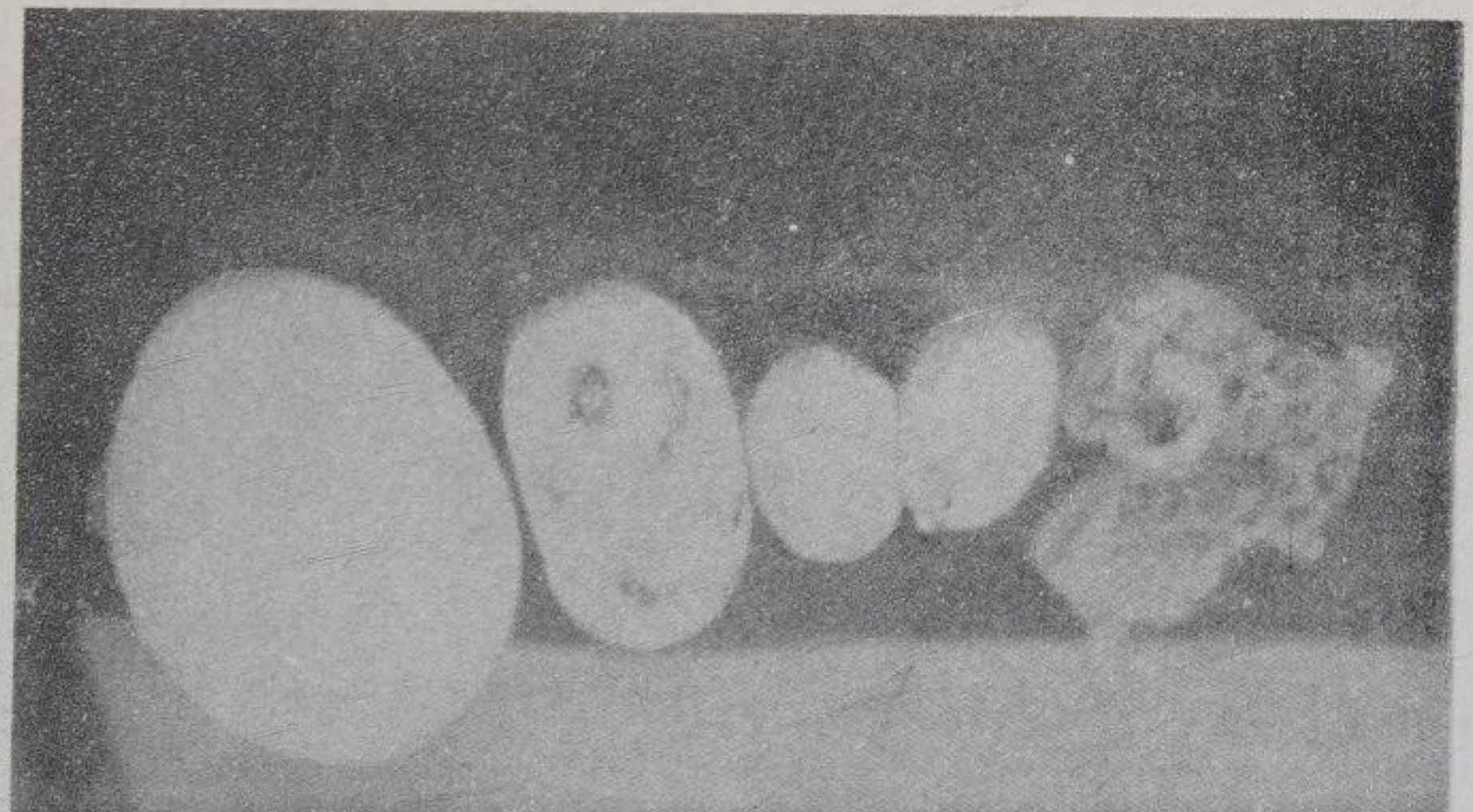
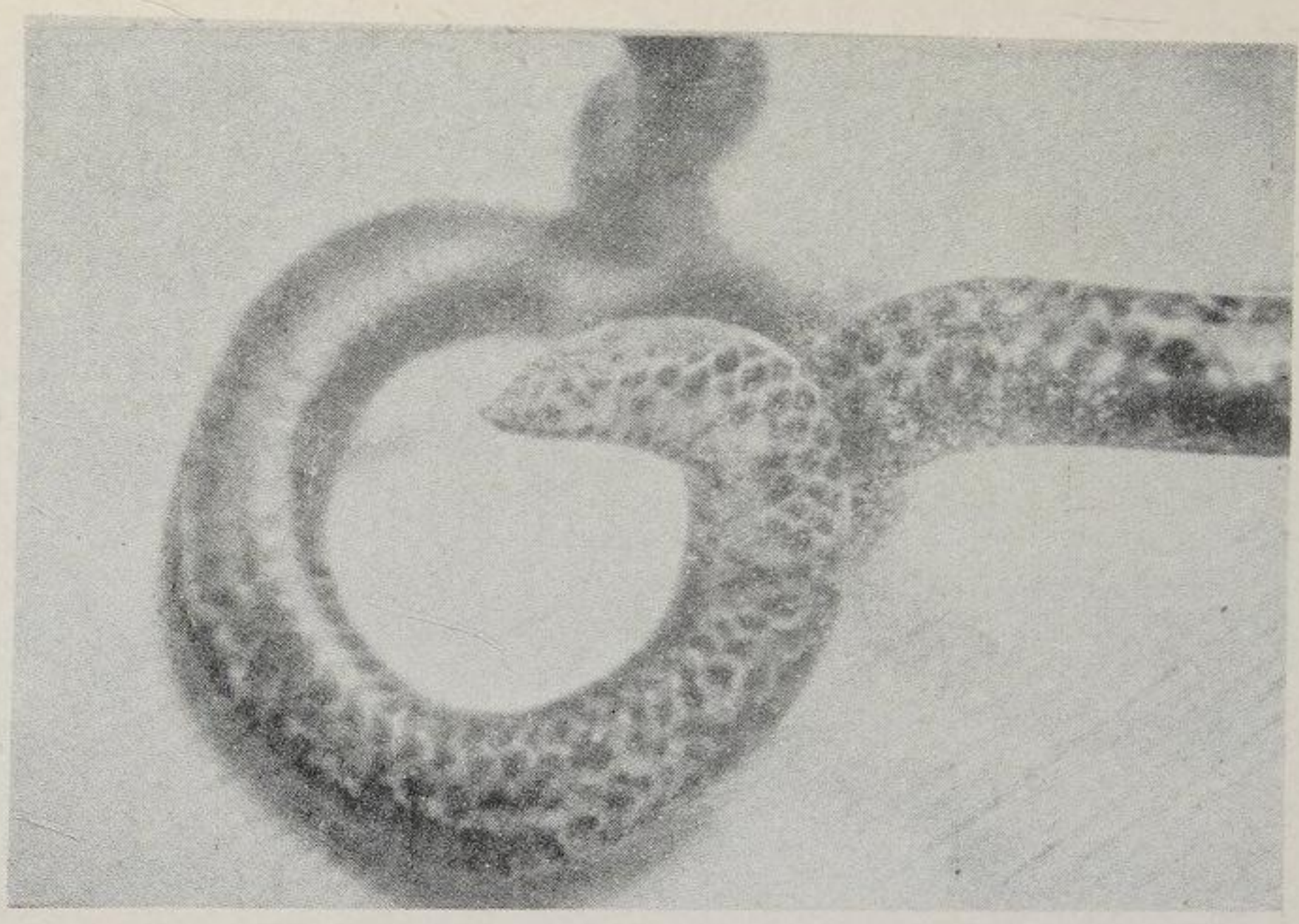
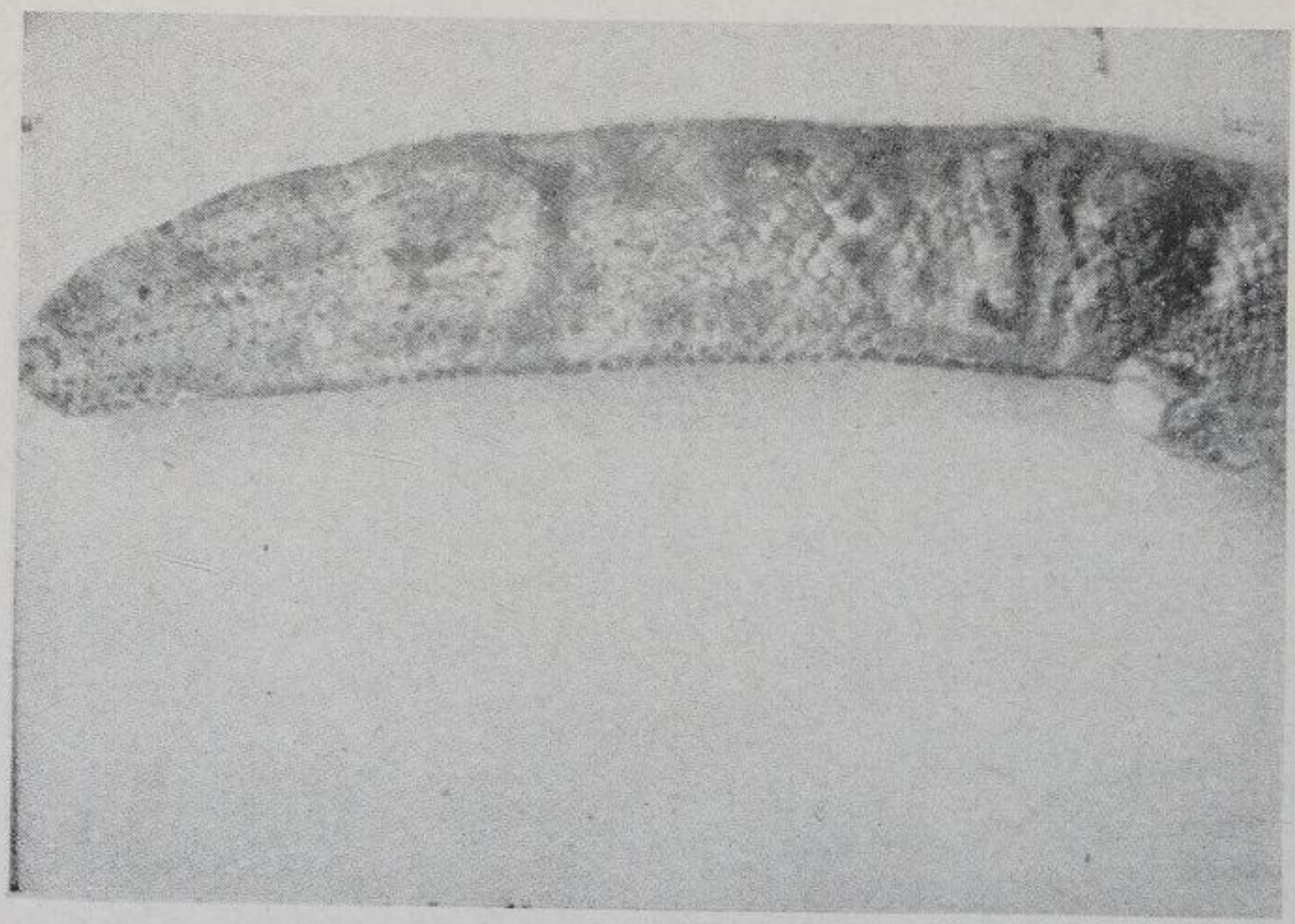


Plate 29. Photograph showing the comparative sizes and shapes of fowl egg, rat snake egg, Cobra egg, Krait egg and embryos of Russell's viper.

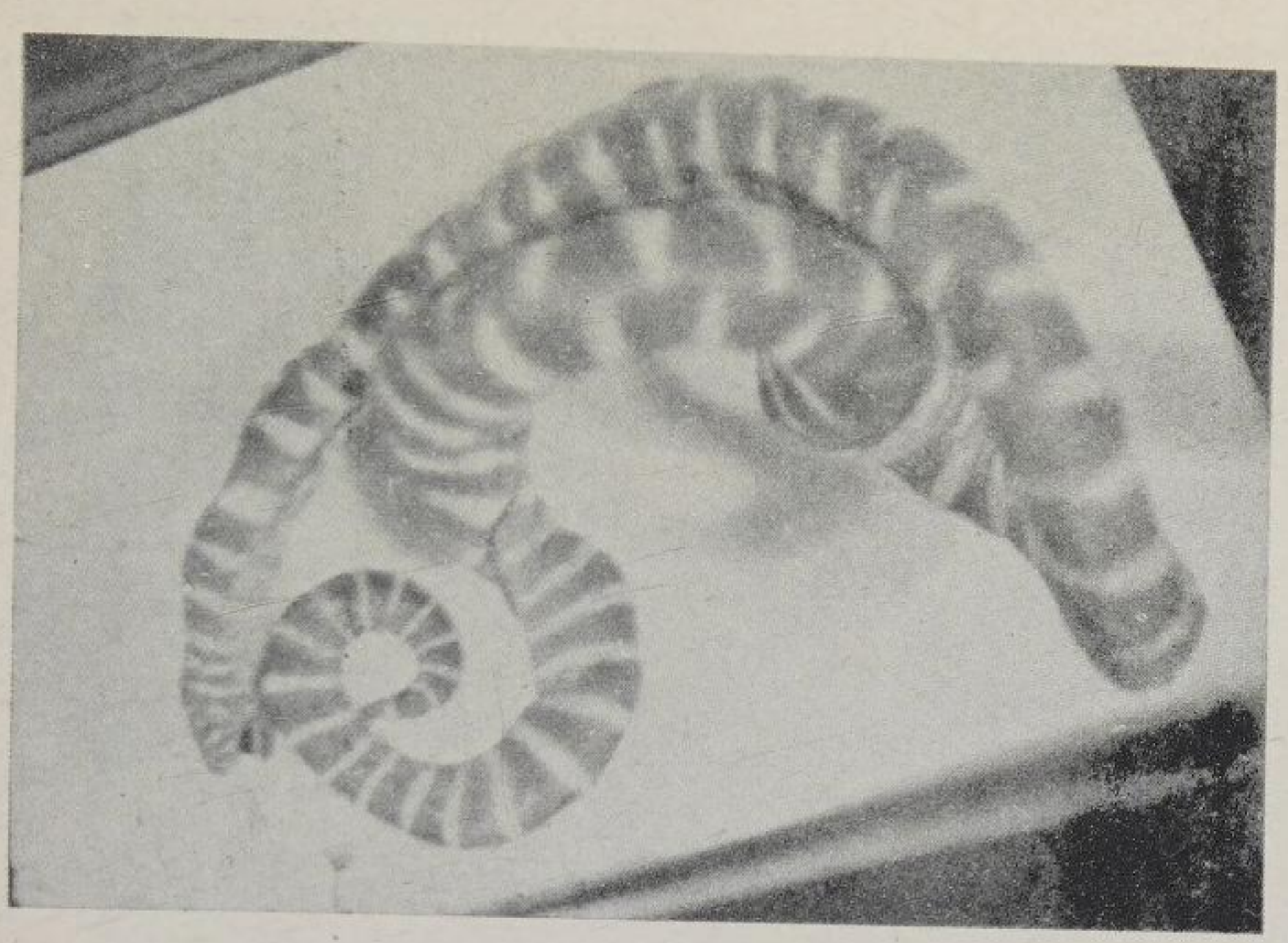


(a)

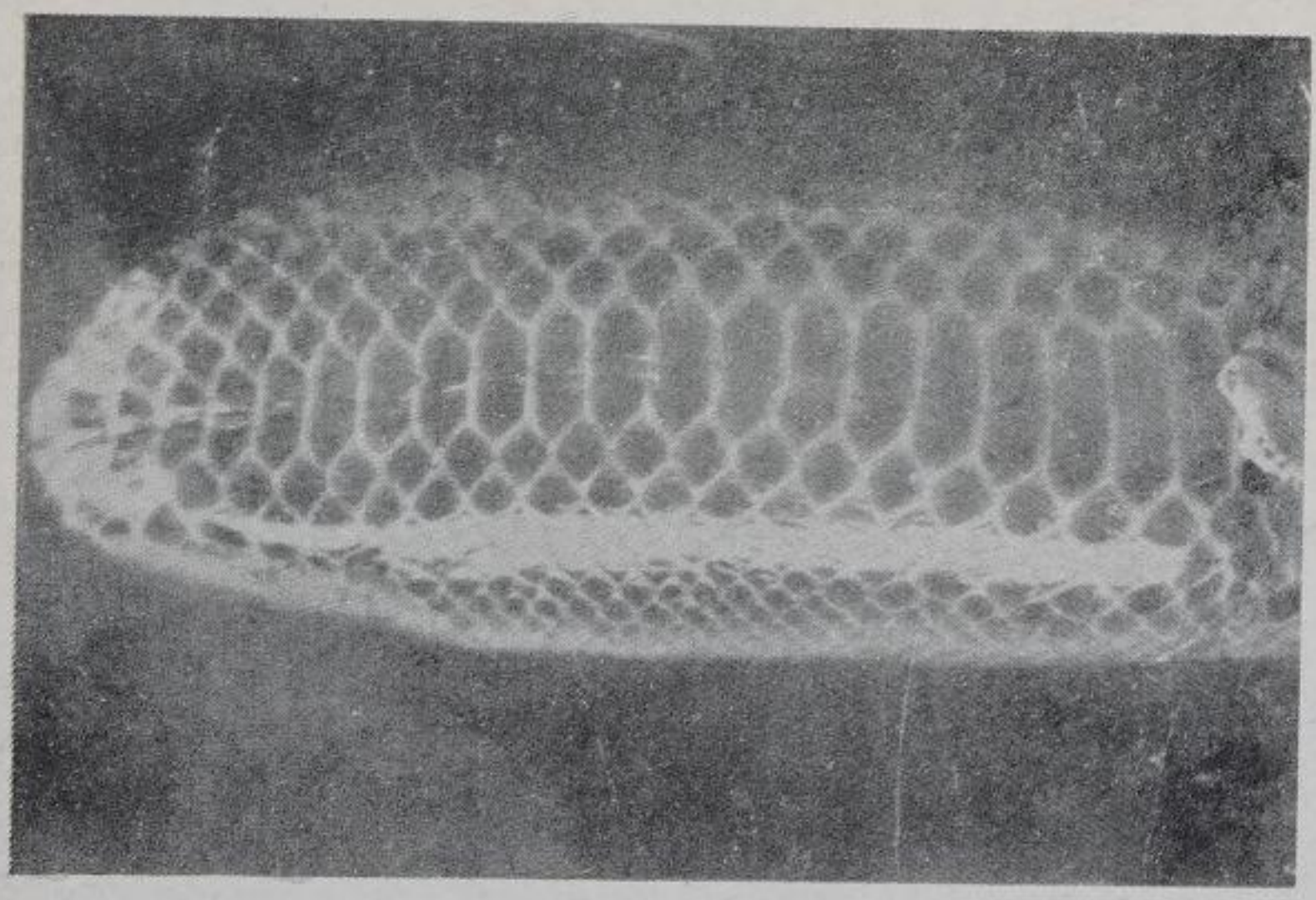


(b)

Plate 30. Tails of different snakes
(a) Rough tail-end of Uropeltidae
(b) Flat tail of sea snake showing ventral scales as only a ridge
(c) Oarlike tail of a sea snake
(d) Blunt tail of a sand boa



(c)



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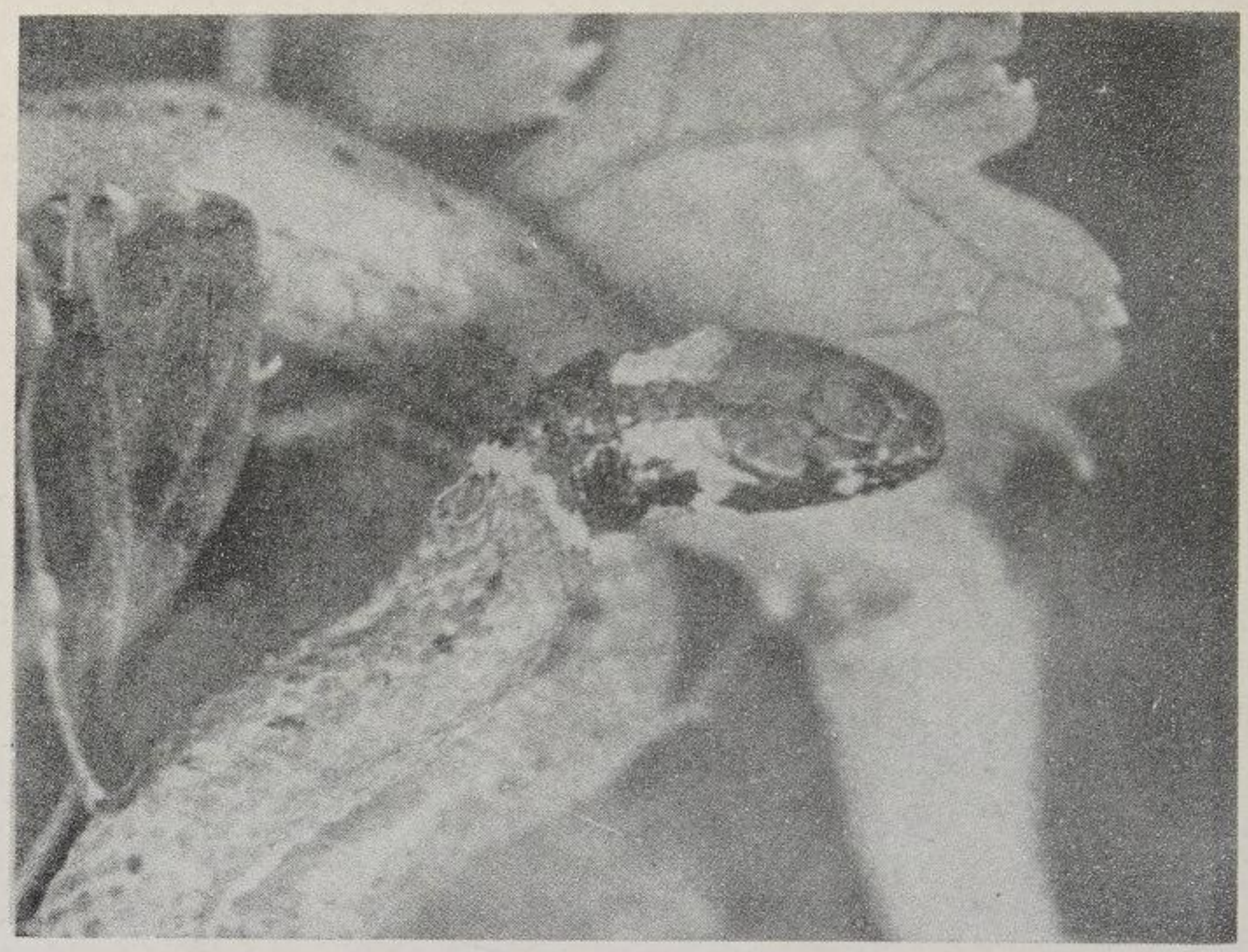
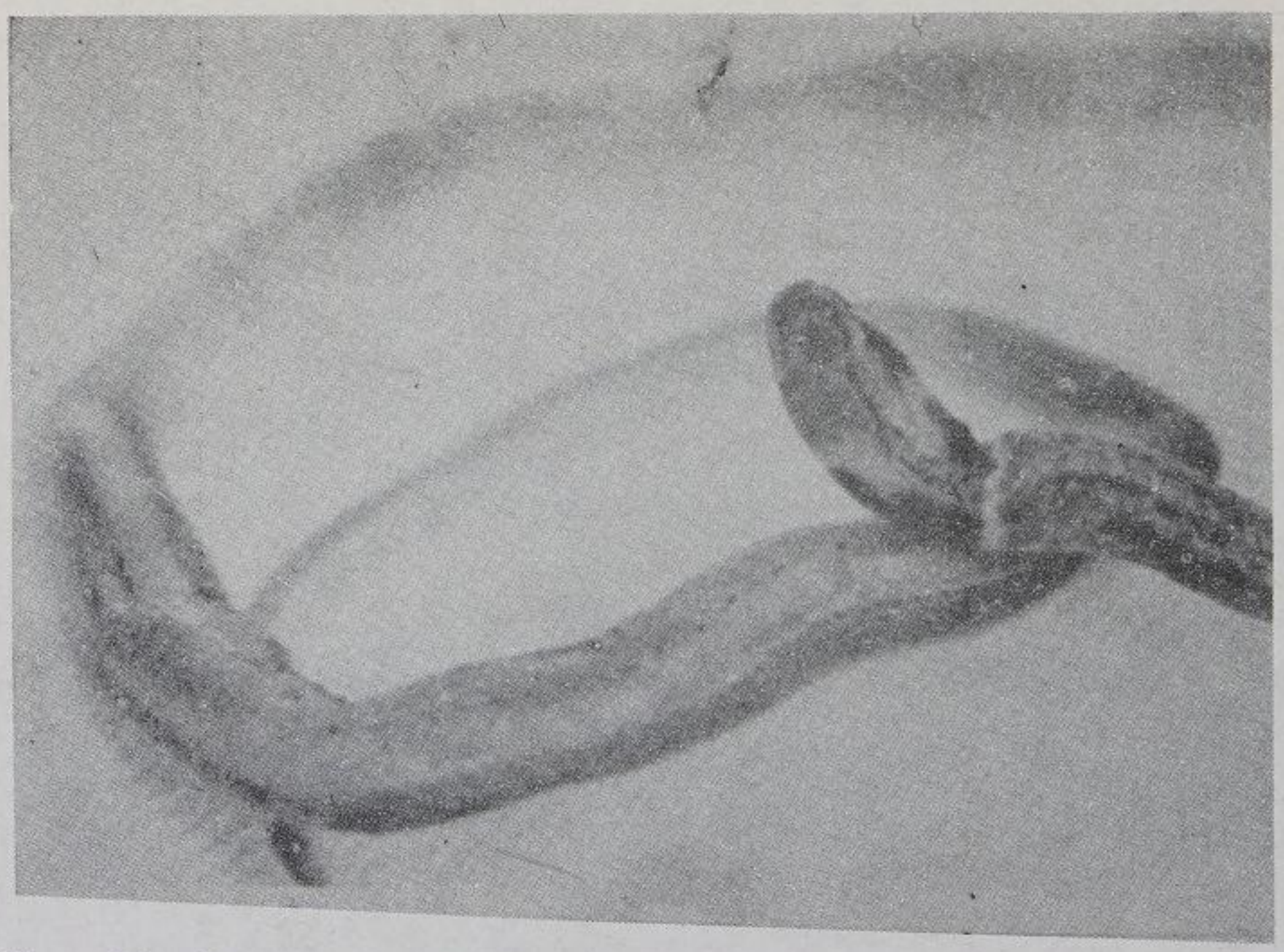


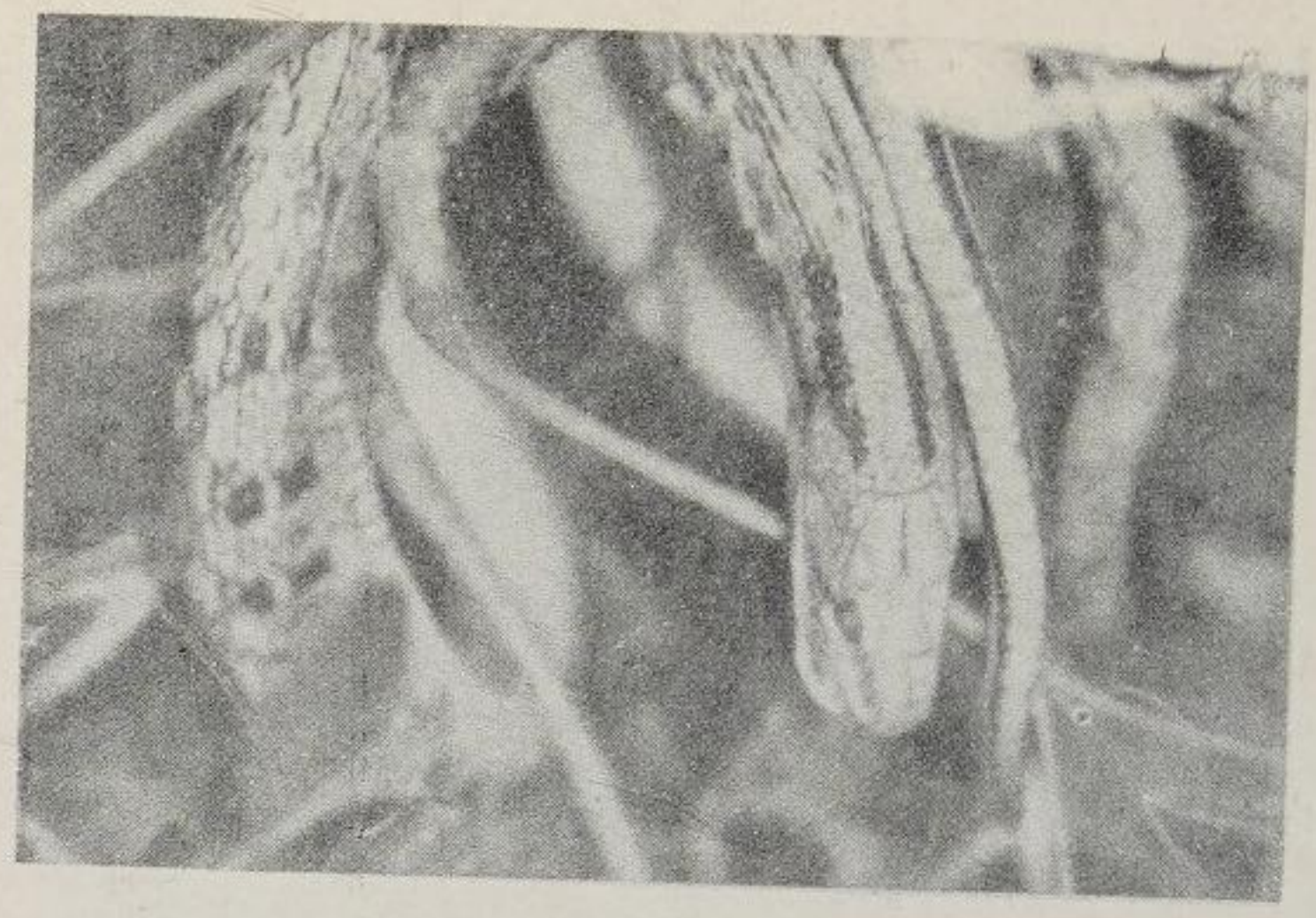
(a)



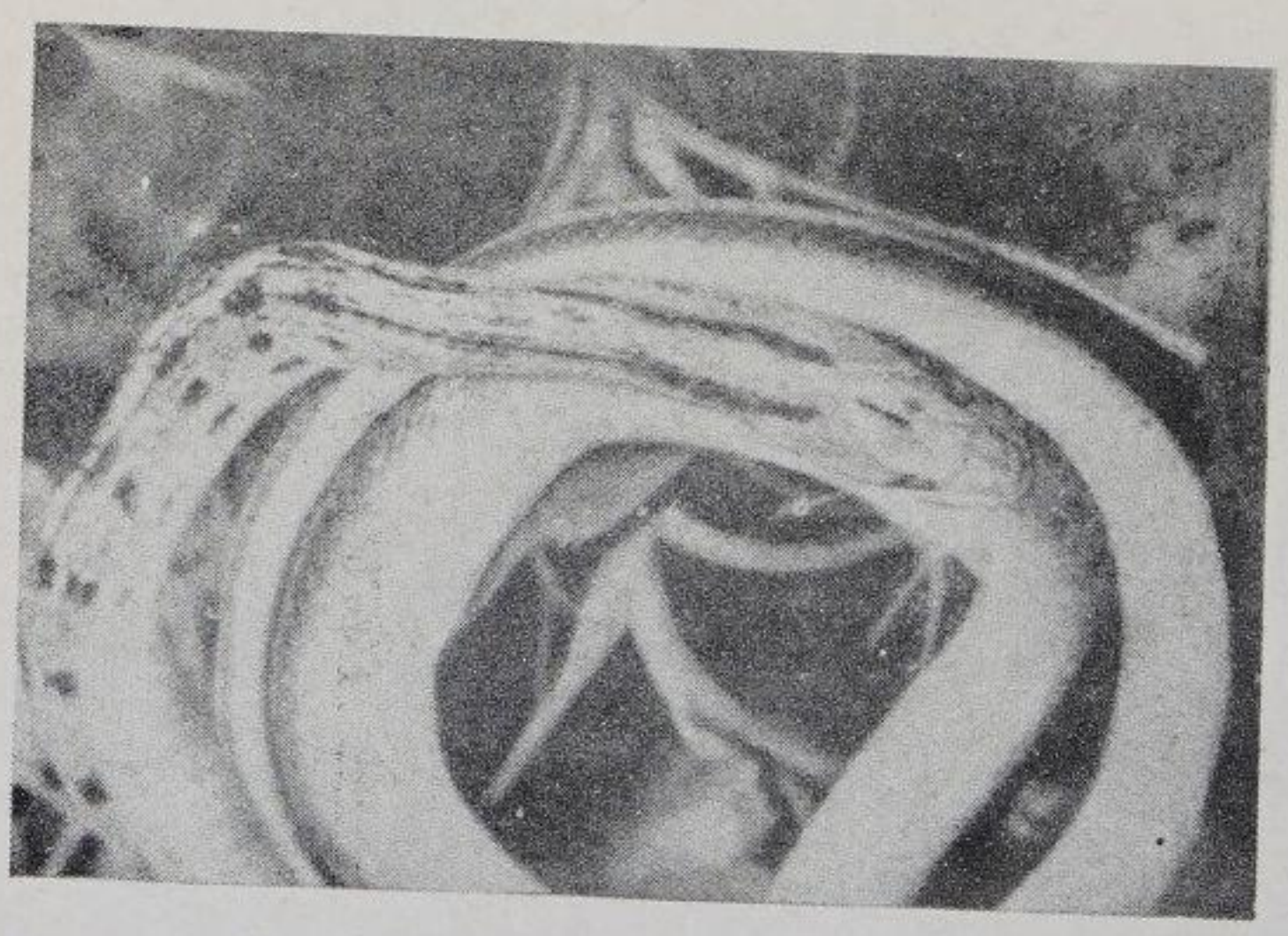
(b)

Plate 31. Coral snake (Callophis melanurus)
(a) Showing head scales and dark bands
(b) General appearance

Plate 32. Typhlops braminus
The snake on a croton tree showing imbricate scales.



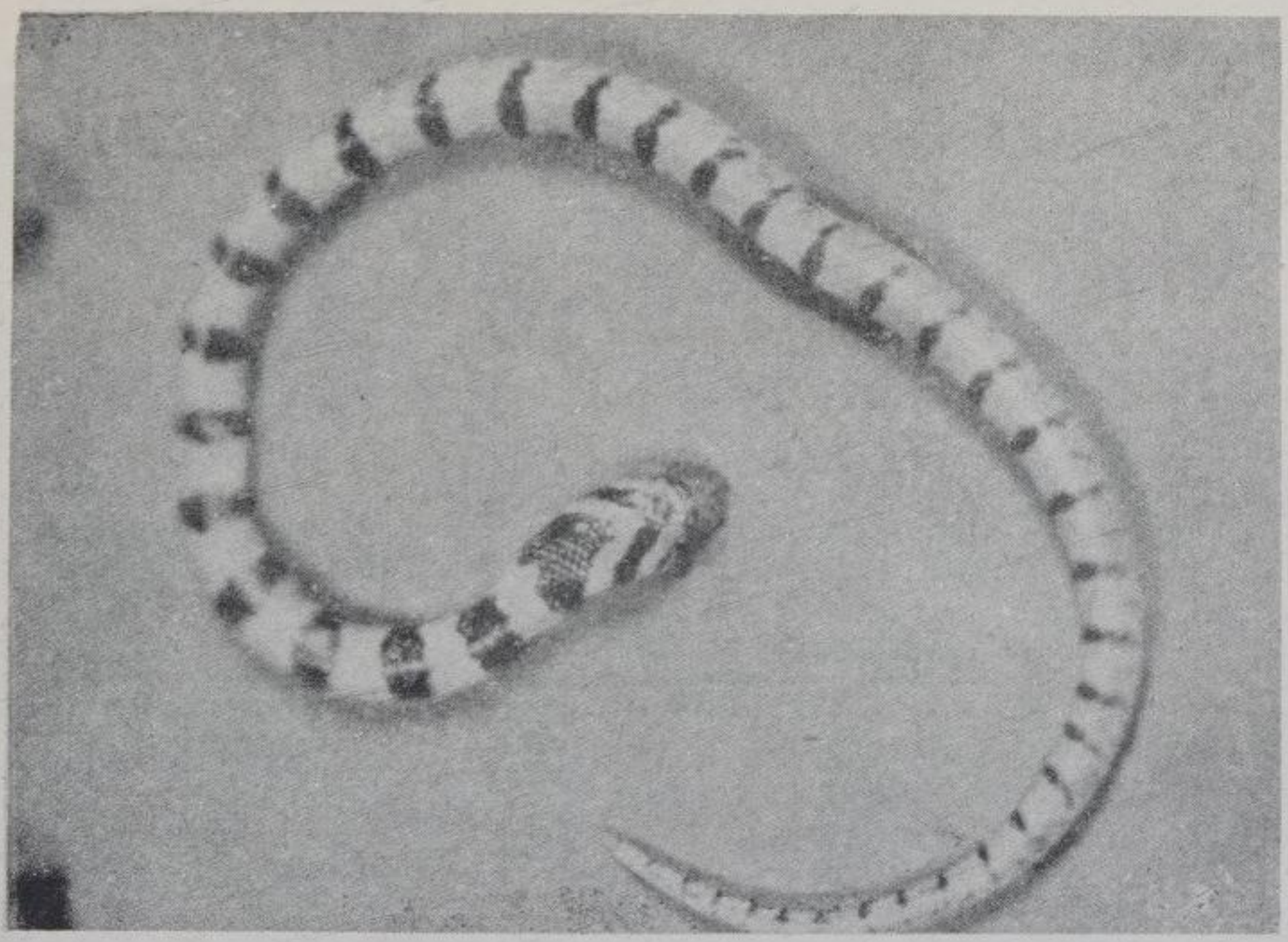
(a)



(b)

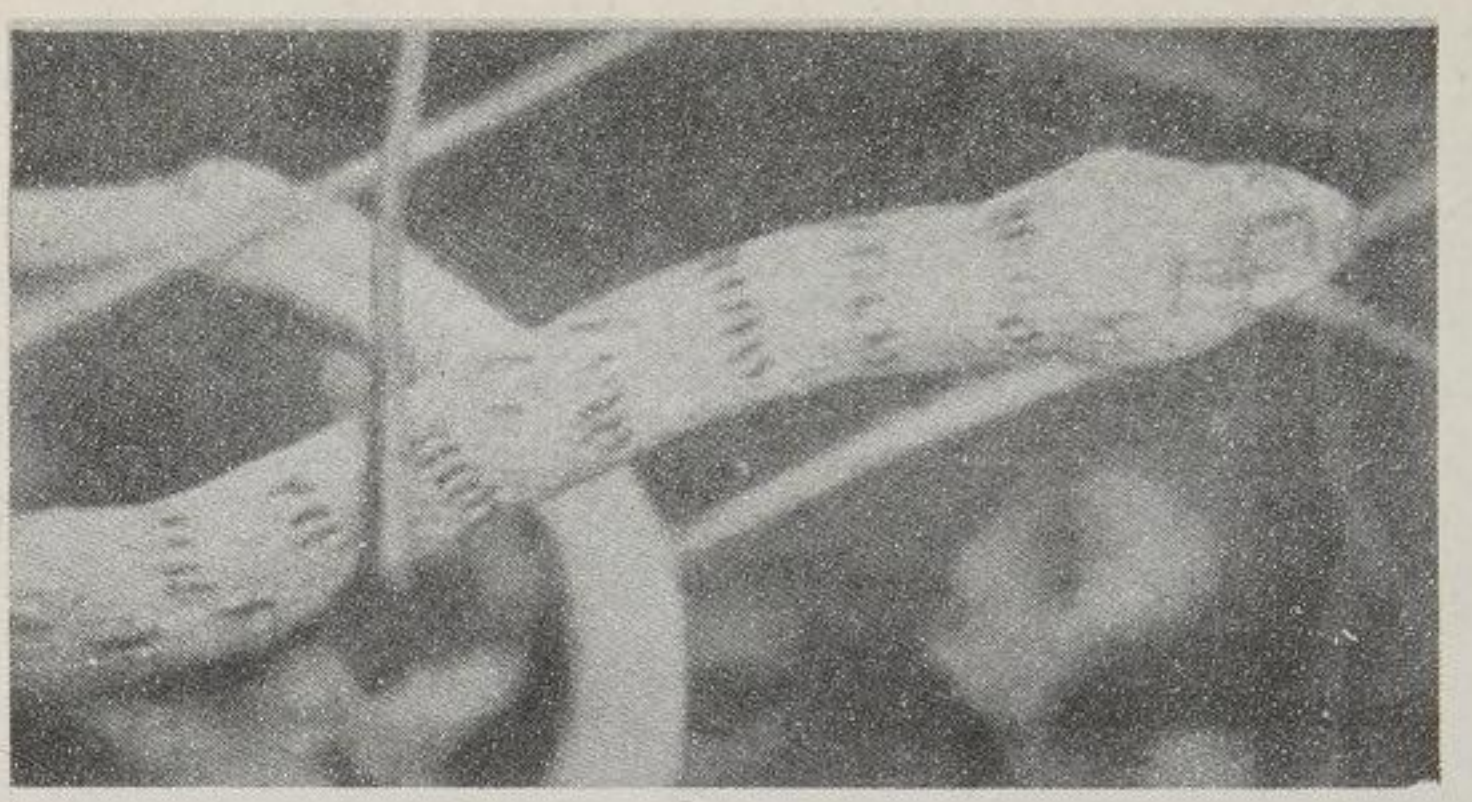
Plate 33. OLIGODON
(oligodon venustus)
(a) & (b)

(a)

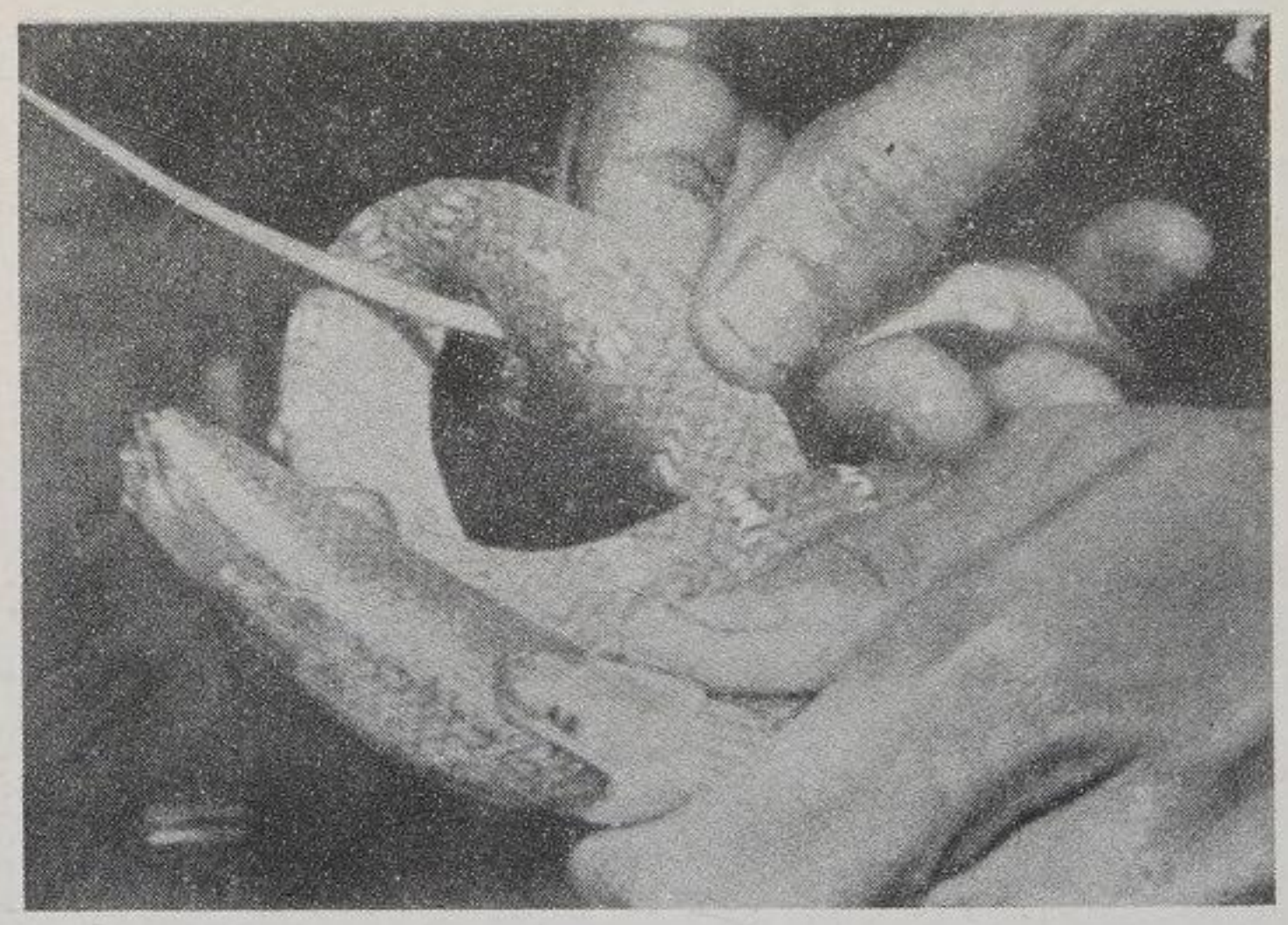


(b)

Plate 34. Oligodon arnensis
(a) On a croton shrub
(b) Life size



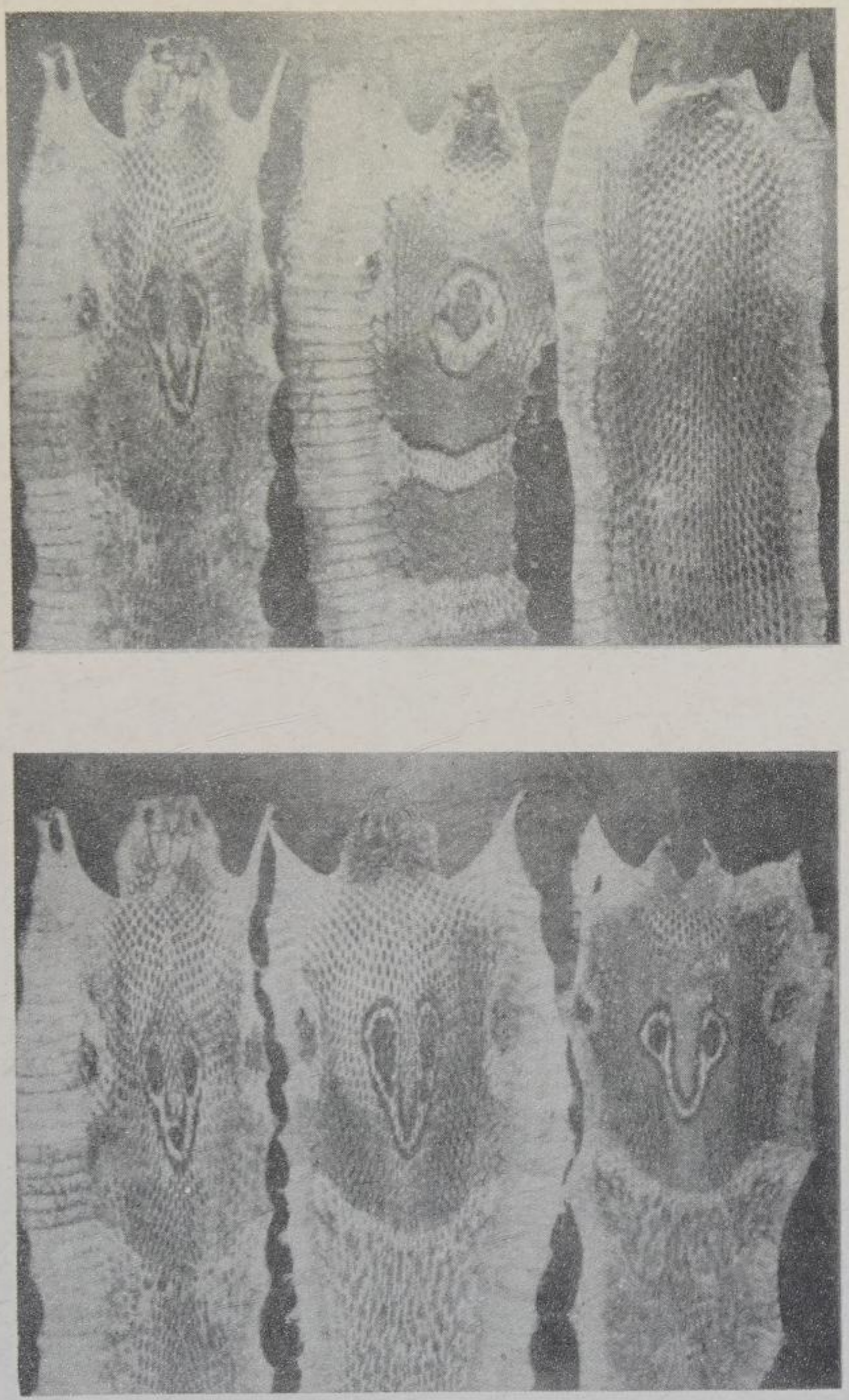
(a)



(b)

(c)

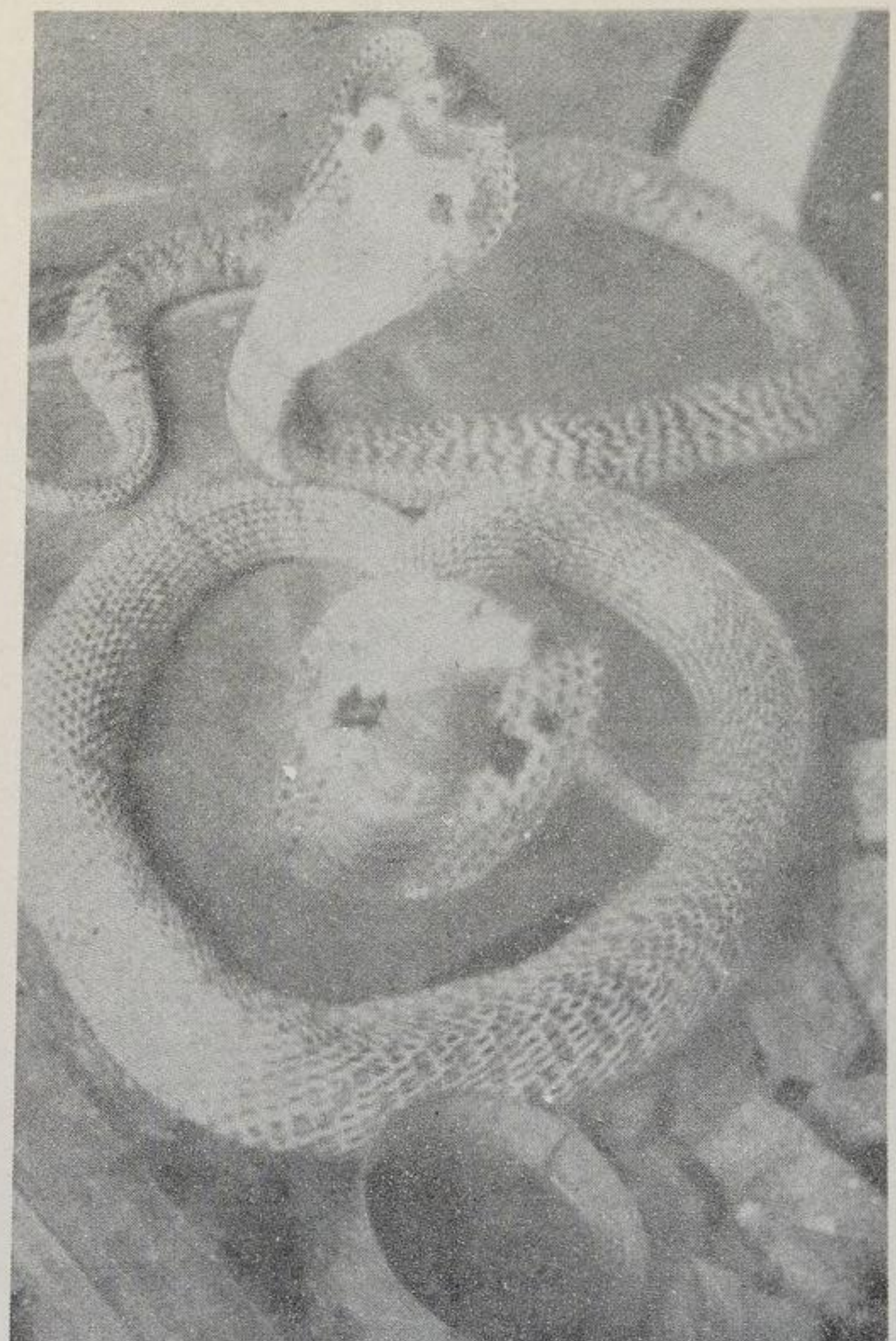
Plate 35. Common Wolf Snake (Lycodon aulicus)
(a) Snake going up a bush
(b) Snake caught swallowing a skink
(c) Living Lycodon showing the size in handling



(a)

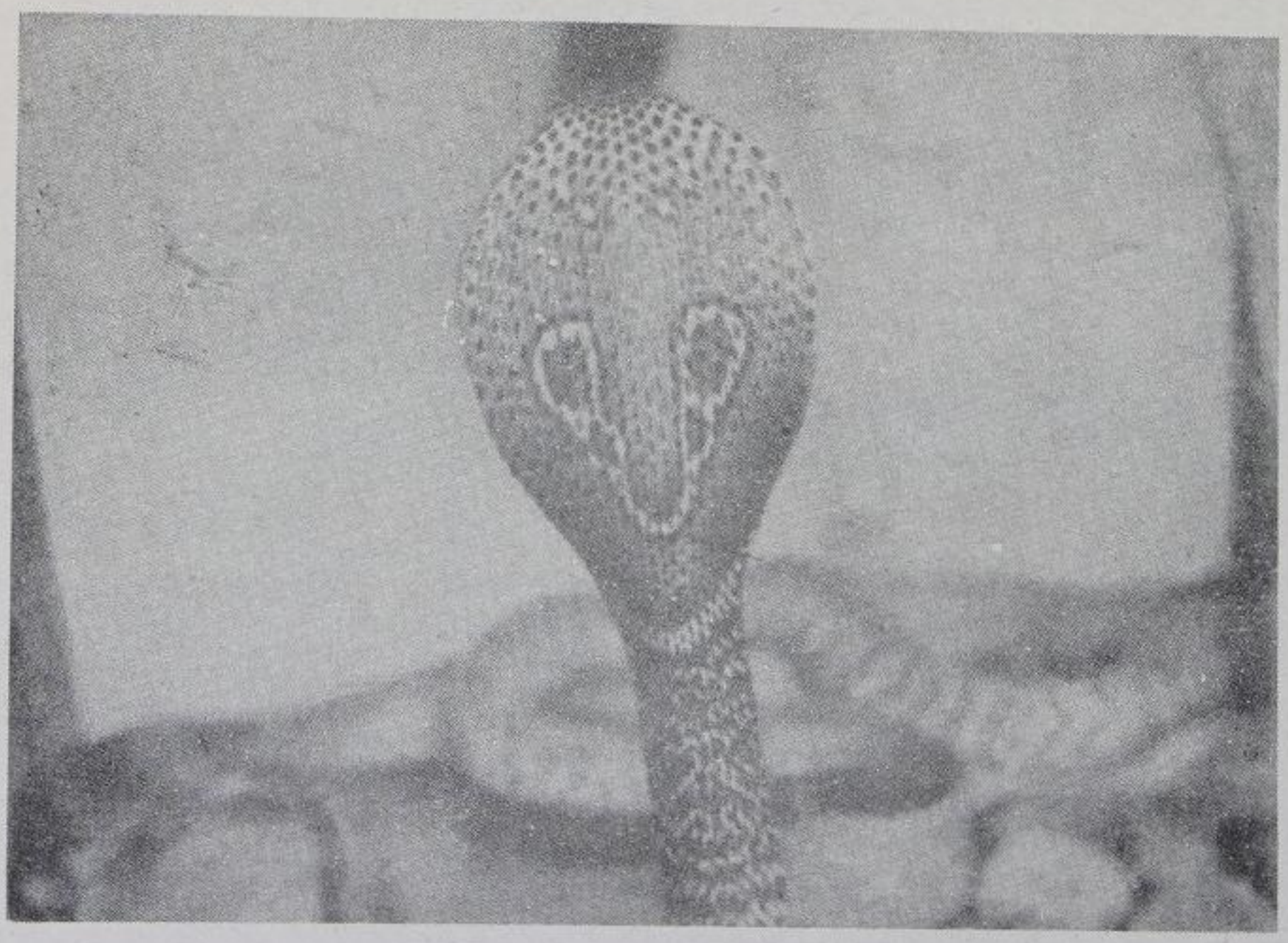
(b)

Plate 36. Skins of cobras showing the different marking pattern on the head
(a) Binocellate, moncellate and ascellate marks
(b) Different kinds of binocellate pattern



(a)

Plate 37. Hood of Cobras
(a) Ventral side of hood showing two black spots and three faint black bands
(b) Dorsal side of the head showing the binocellate mark



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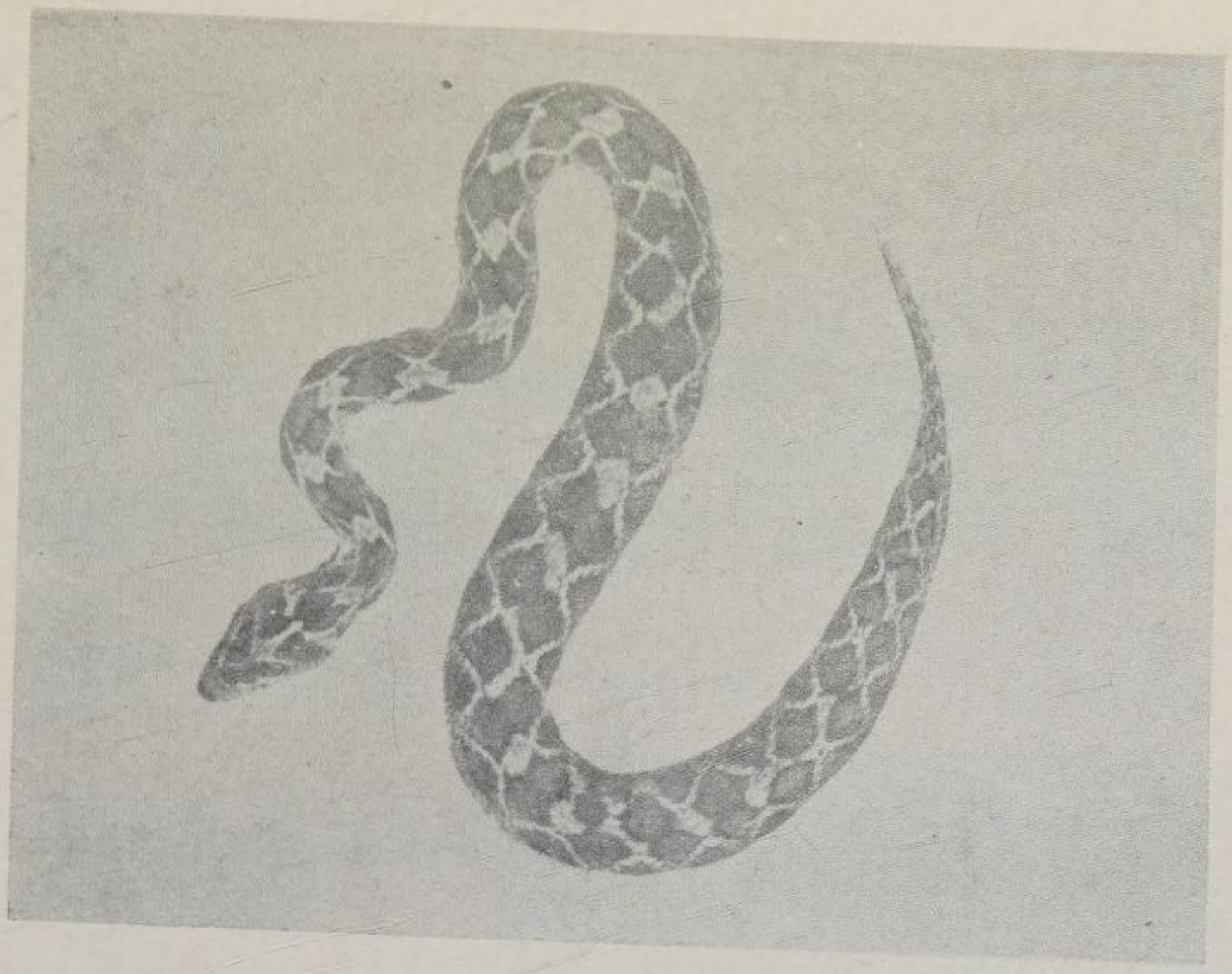
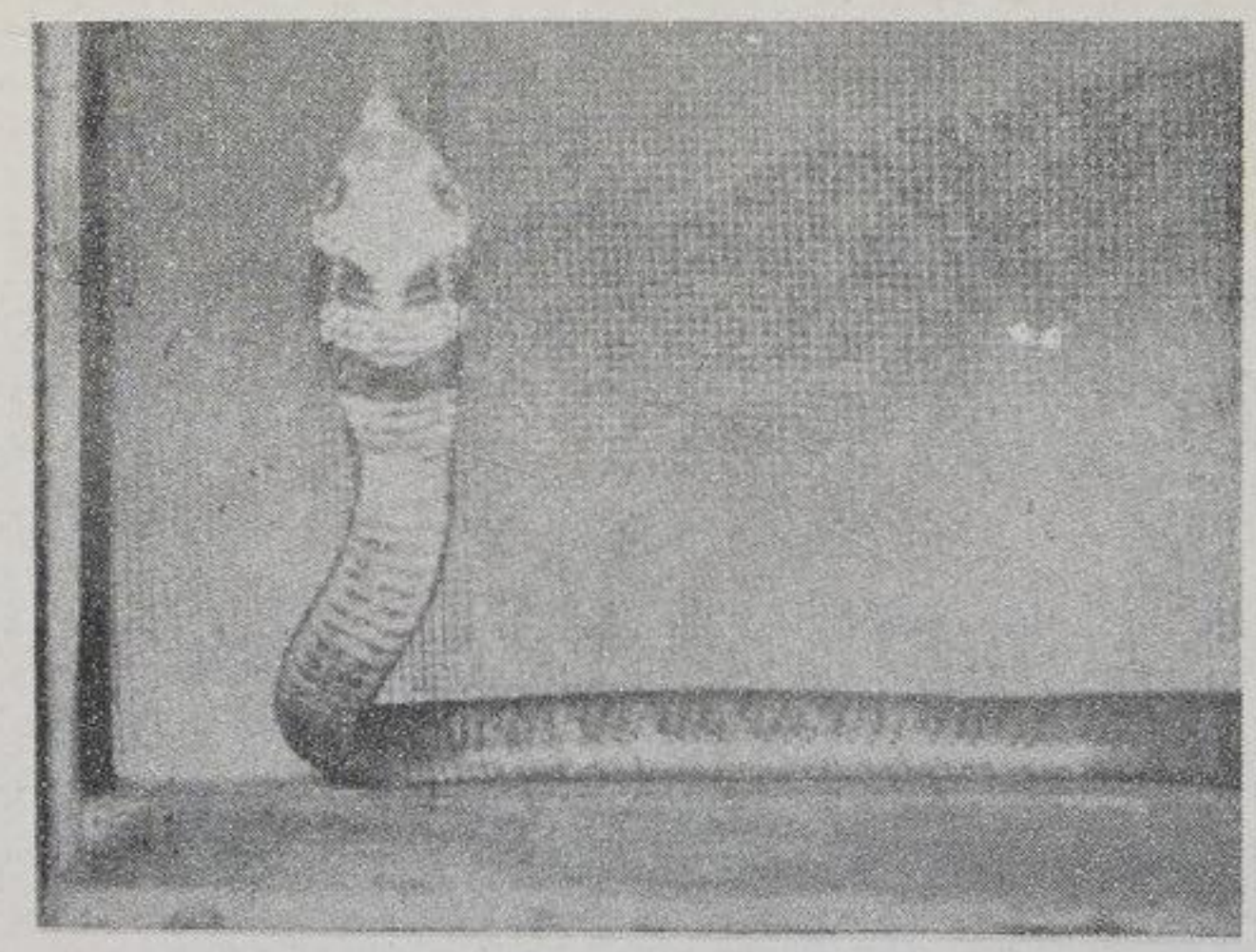


(a)

(b)

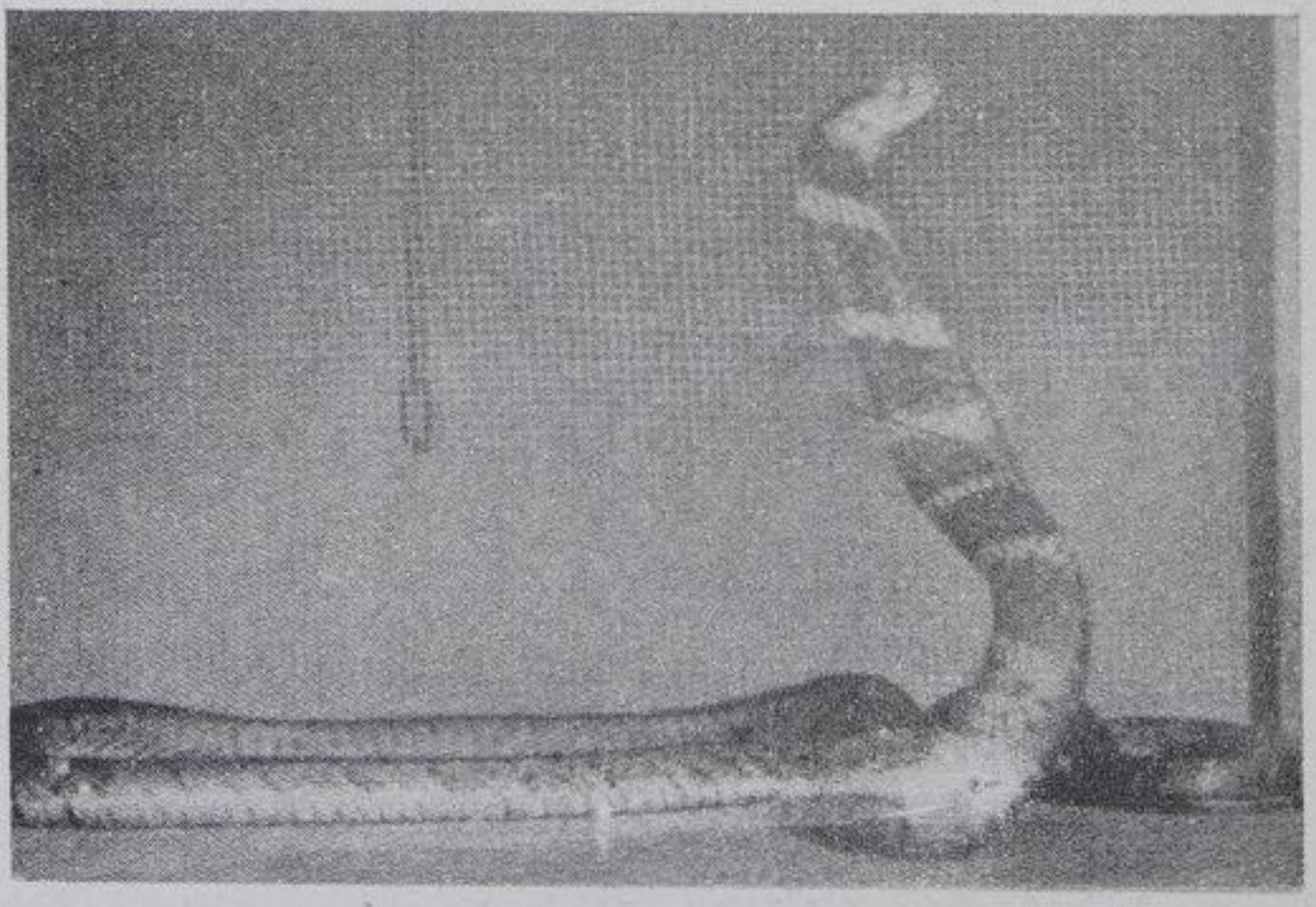
Plate 38. Echis carinatus
(a) Arrow head mark on the head
(b) Camouflaged Echis carinatus on a rock

(a)



(b)

Plate 39. King Cobra (Naja hanna)
(a) Hood shown dorsally to show "occipital shield" and yellow bands.
(b) Hood shown ventrally for two cross bands and a corner black spot.
(c) Lateral view show the size of the hood.



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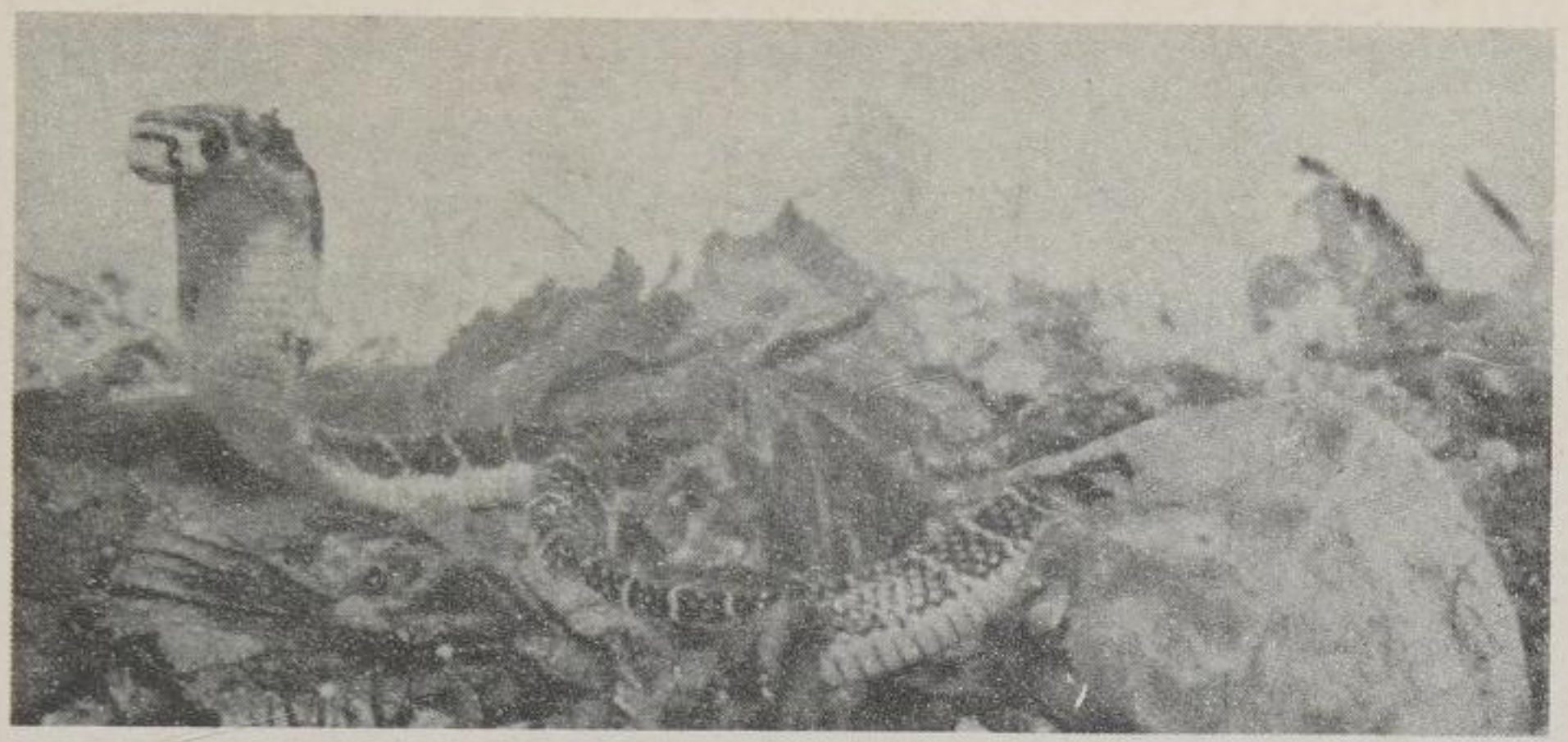


Plate 40. King Cobra hatching out of an egg. (Photo : New York Zoological Society–The Zoological Park)

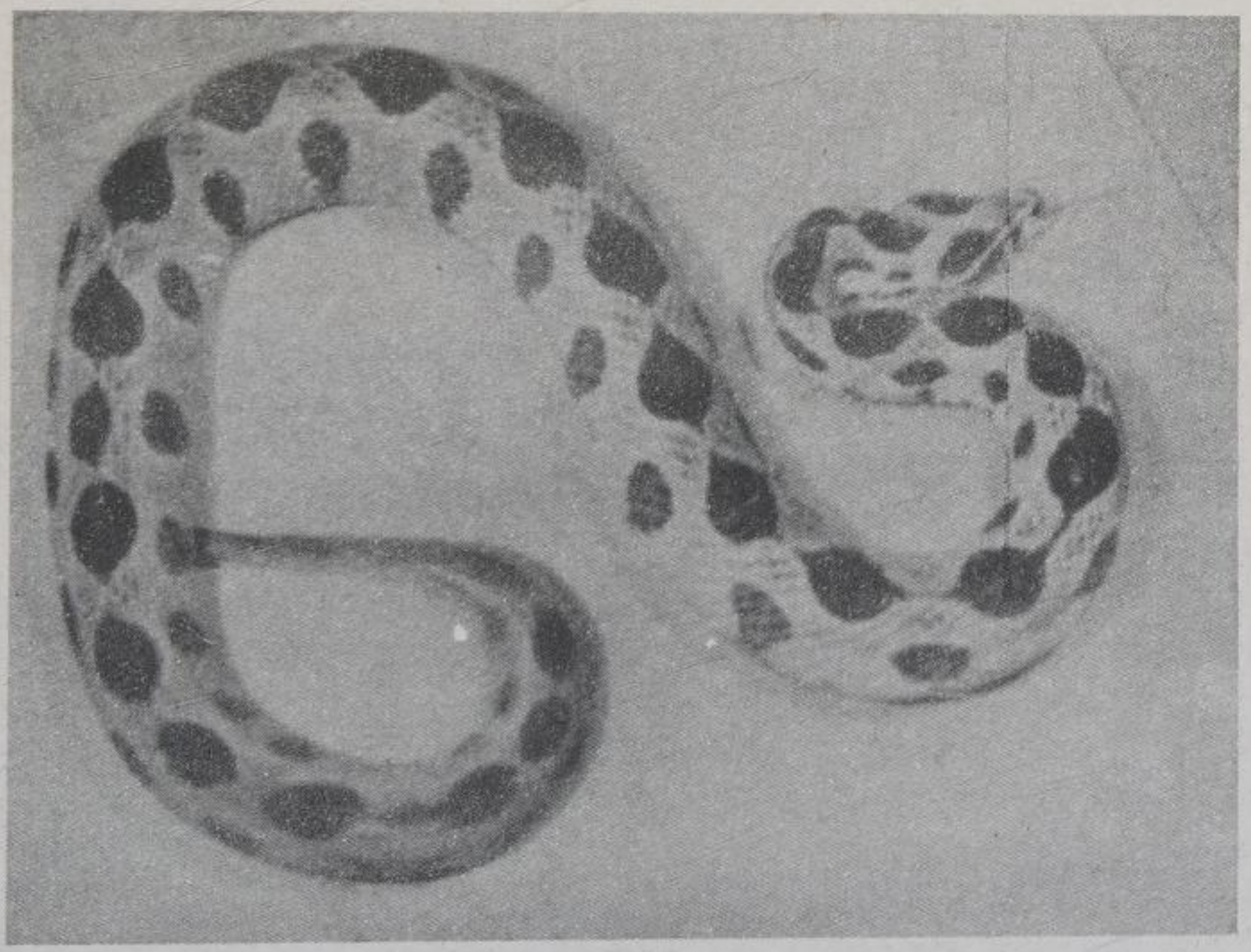


Plate 41. Russell's viper (Vipera russelli)

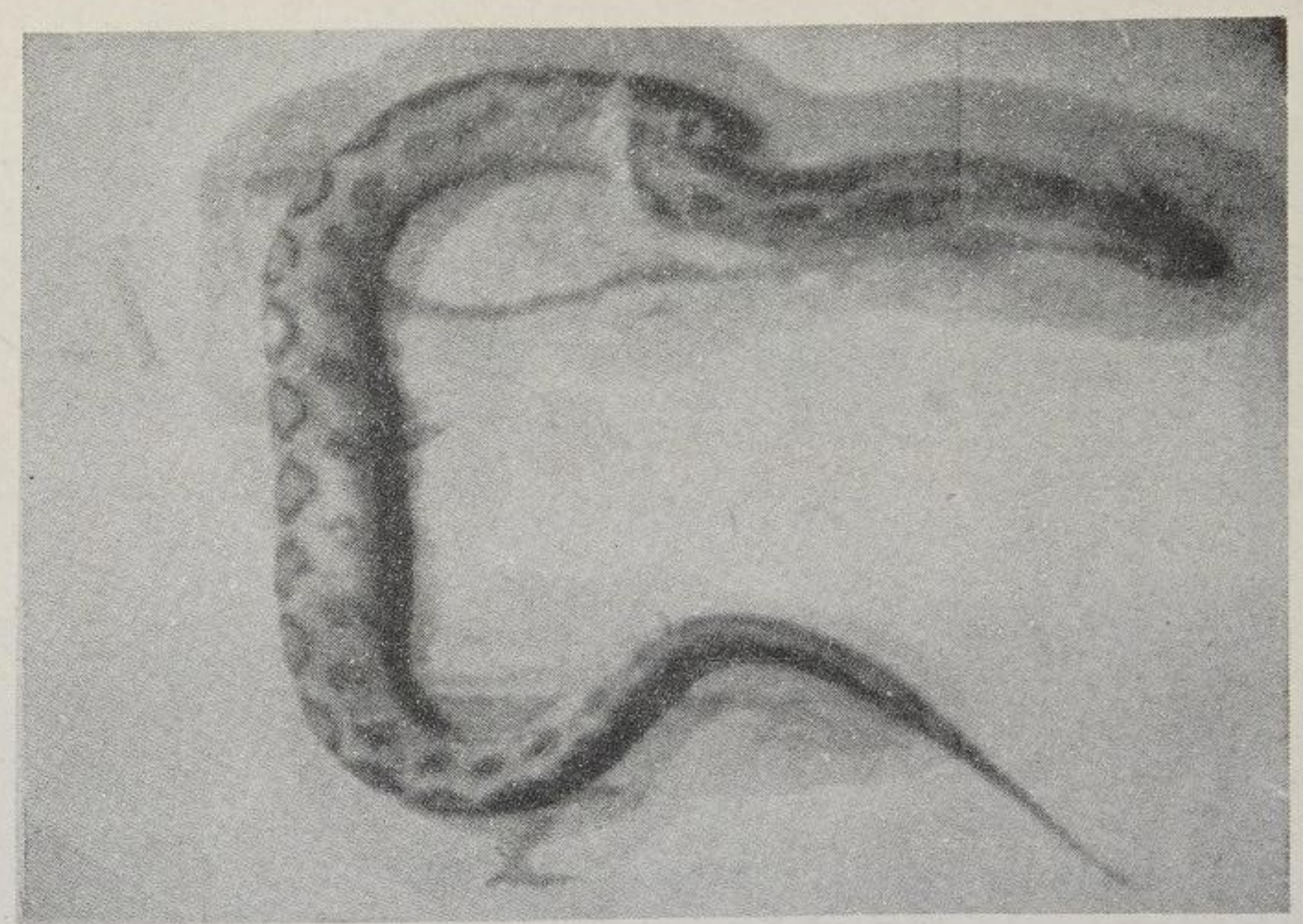


Plate 42. Cannibalism. Russell's viper eating another young one

Python reticulatus is also a good climber, but very few authentic records of this snake are available in India. The green pit viper, *Trimeresurus gramineus*, is found on bamboo trees. It is a poisonous snake. The colour is leaf green and the head typically triangular.

The ground snakes have well-developed scales on the head and body. The body scales are well-defined into dorsal and ventral and many of these scales have been modified into scutes, tubercles, serrations and spines. The body is developed for land progression, chemoreceptive organs are present, hissing, and the capacity to raise a part of the body menacingly are well developed. Their main food is mammals, but they do eat frogs, slugs, insects, lizards, scorpions and snakes. This group of non-poisonous snakes have a well-developed, strong muscular body. Both the lungs are present. The poisonous snakes have a smaller, less muscular body, one of the lungs has either been reduced, atrophied or absent and there are special teeth, called fangs, on the upper jaws. These fangs, unlike the teeth, are specially developed and have a canal or gutter and are replaceable, when broken, by new teeth from the buds at the sides of the fangs. The modified parotid gland injects the poison into the upper opening of this fang for transmission to the wound. This development is not seen in non-poisonous snakes.

To the category of non-poisonous ground snakes belong pythons, trinket snakes, racer snakes, while the Cobra, Krait, Russell's viper and Saw-scaled vipers belong to the poisonous group.

Details of classification of snakes are based on the scales present on the body and head of the snake. These scales have particularly been modified into special characteristics which for identification are called shields. These shields are most prominent on the head and the upper and lower sides of the snake's body.

The arrangement of scales provides a basis for identification, as shown below. At the end are given broad descriptions of 36 common snakes of India with their pictures wherever available.

The blind snakes which are primitive have imbricate scales (semi-circular) all over the body and their tail ends are blunt.

I. Enlarged drawing of head scales.

A–Rostral
B–Internasal
C–Nasal
D–Prefrontal
E–Loreal
F–Preocular
G– Frontal
H– Supraocular
I– Postocular
J– Parietal
K– Mental
L– Occipital
M– Pit
N– Superalabial
8– Infralabial

II. Head scales, a different view.

III. Head scales seen ventrally.

IV. Cobra head showing third supralabial touching the masal and eye and a triangular shaded wedge between fourth and fifth infralabial and three postoculars.

V. The small scales on the triangular head of a Russell's viper.

VI. Showing the pit in a pit viper.

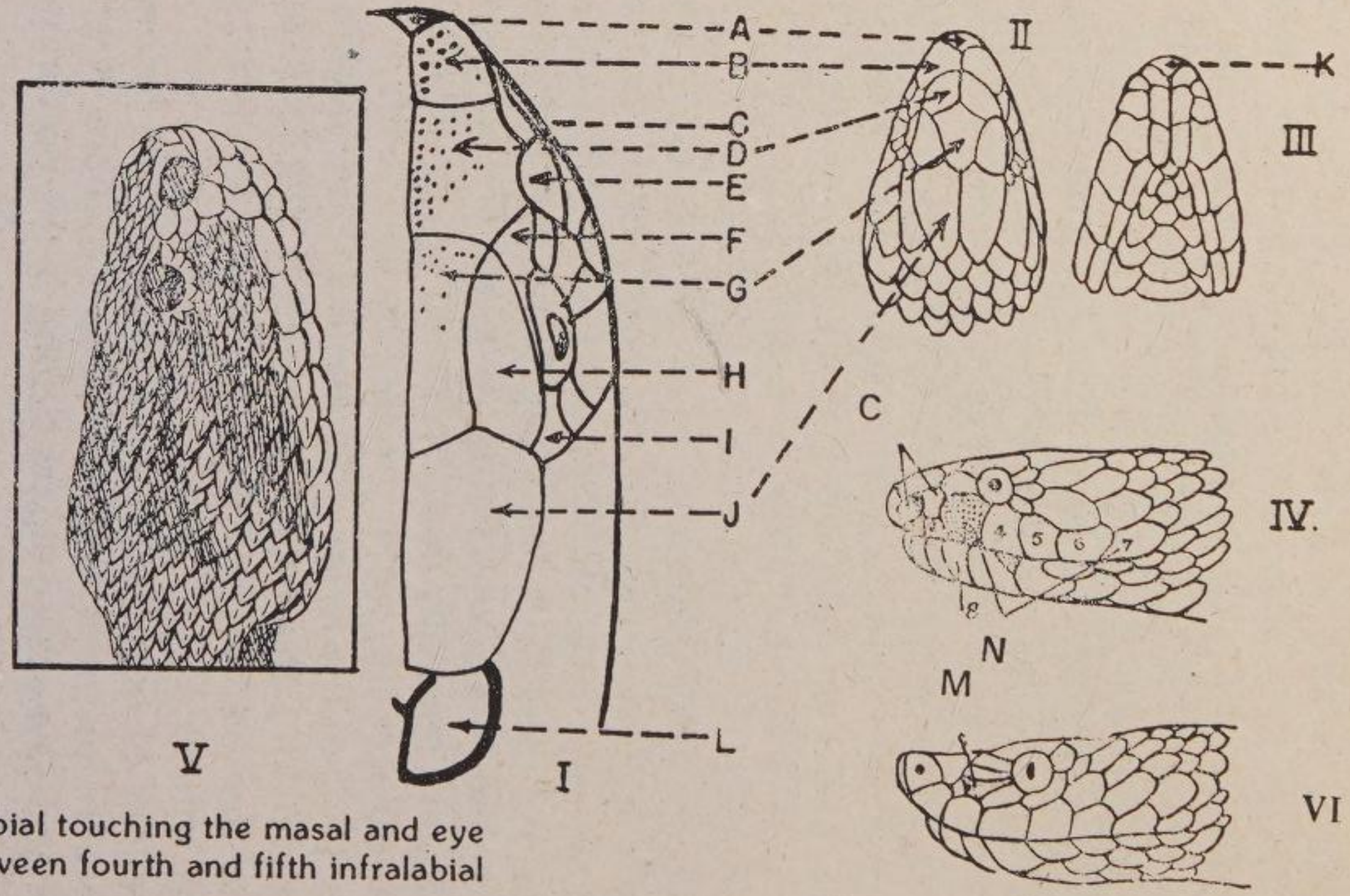
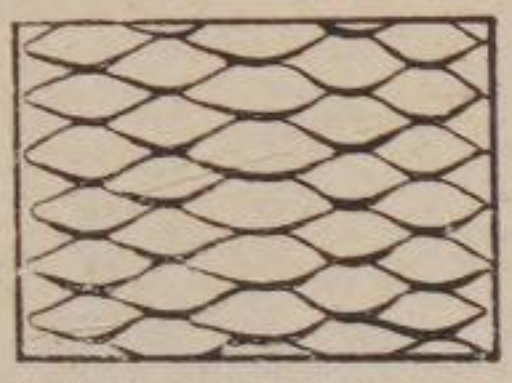
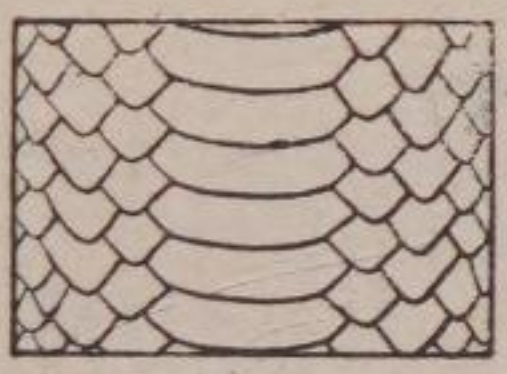


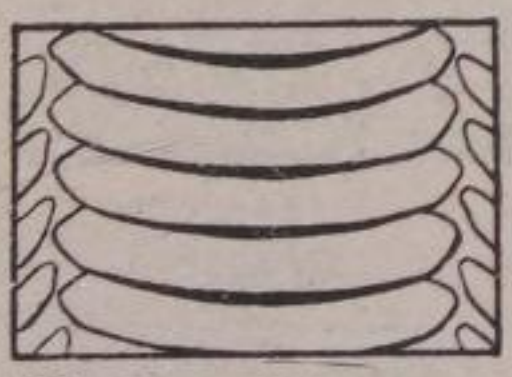
Fig 10 Names of different head scales in a snake.



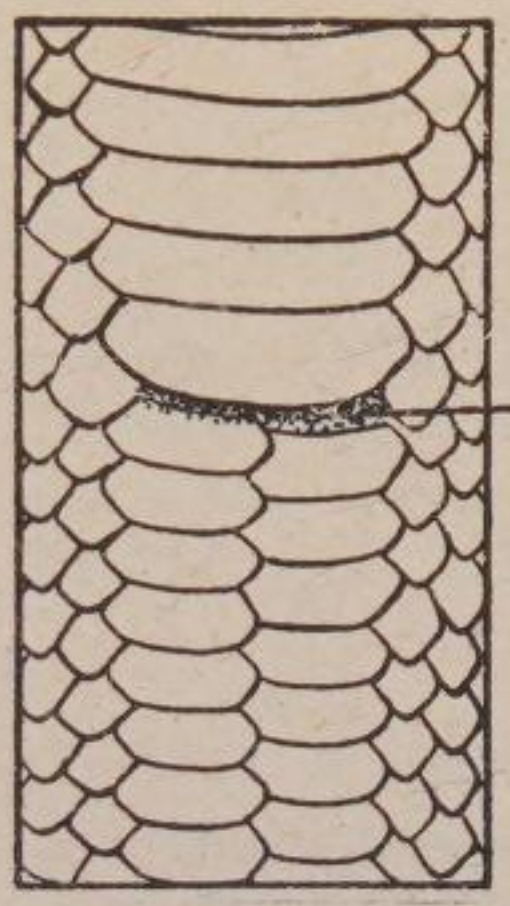
(1) Semicircular or imbricate scales all over the body as seen in a primitive snake.



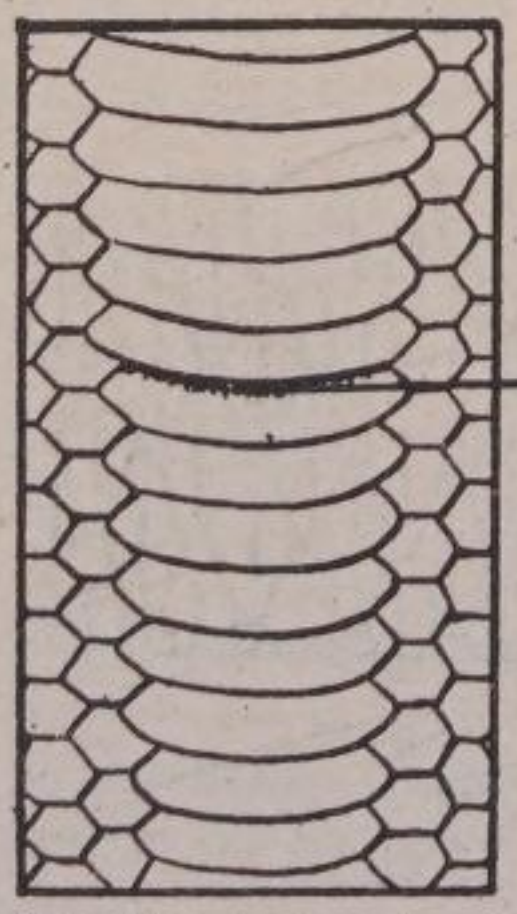
(2) The ventral surface showing part cross ventral and part small dorsal scales as seen in a python.



(3) Complete cross scales on the belly as seen in a rt snake or a cobra.



(4) Ventral scales near the vent region. Beyond the vent these scales are in two rows as in a cobra.



(5) Ventral scales in a single row even beyond the vent as seen in a Krait.
(a) Vent.

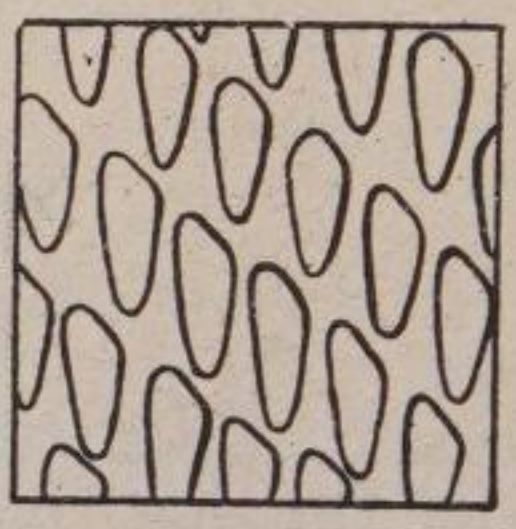
Fig 11 Body Scales.

(1)

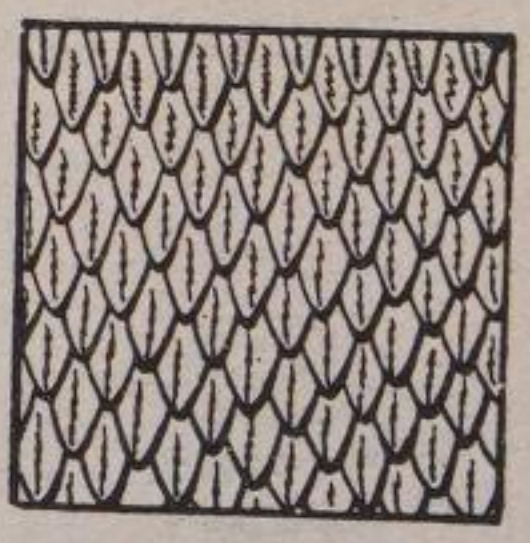
(2)

(3)

(4)



(5)



(6)

Fig 12 Scales on the upper (dorsal) side.

(1) Central row of dorsal scales, big and hexagonal, as seen in a Krait.

(2) Oblong scales with a line as seen in a rat snake as compared to (5) rhomboid scales with space in between as seen in a cobra.

(3) and (4) Scales in a Russell's viper. Semi-elliptical with a thin line in the centre (6) overlapping elliptical scales with serrated lines like a saw seen behind the head in *Echis carinatus*.

They could be distinguished from an earthworm by the absence of lines of segmentation and the presence of these scales; apart from teeth, tongue, bones and other vertebrate characteristics. The more highly evolved snakes have well-defined and designed scales on the head and on dorsal and ventral surfaces of the body. The variation in these scales seen in different snakes forms the basis of identification.

Identification by Scales

Primarily the head consists of certain basic scale shields enumerated in *Figure 10*. These are named rostral (A), internasal (B), nasal (C), prefrontal (D), loreal (E), preocular (F), frontal (G), supraocular (H), postocular (I), parietal (J), mental (K), occipital (L), supralabial (N), and infralabial (8).

In the picture one can see the large-size line drawing showing the dorsal head scales along with the small-size drawings showing the dorsal, ventral, side views of snake heads giving the scales and the area of the pit (Pit VI-M).

On the lower side of the head are the anterior sublingual and posterior sublingual shields.

The head in a primitive snake does not show this differentiation in scales. In a sand boa and vipers, the head scales are very small and not differentiated. (V)

Table I

Number of Species of Snakes in the Indian Union

S.No.	Family	Genera	Species
	Non-Poisonous		
1.	Typhlopidae	1	14
2.	Leptotyphlopidae	Not in Indian Union	
3.	Uropeltidae	6	33
4.	Antilidae	Not in Indian Union	
5.	Xenopeltidae	1	1
6.	Boidae	2	3
7.	Colubridae	34	112
8.	Dasypeltidae	1	1
		45	164

Poisonous			
9.	Elapidae	3	13
10.	Hydrophiidae	8	19
11.	Viperidae	5	20
		16	52
	Grand total	61	216

On the body of the snakes are scales designated as dorsal when they are on the upper side and ventral when they are on the lower side. The number of scales are counted in a serial row from below to the upper end (*Fig. 12-1*). Beyond the vent (*Fig. 11-4/a*) of the snake on the lower side is a small scale, the *anal*. After this the scales on the lower side, i.e., on the lower side of the tail are caudal which may be paired or unpaired.

The dorsal scales may be elliptical, rhomboid, keeled, with tubercles or serrated. In primitive snakes like Typhlops they are imbricate, i.e., semi-circular. The ventral scales may not be reaching completely the two ends of the belly or they may be complete.

Based on the differences in scalation, the following table is laid out for the identification of non-poisonous and poisonous snakes.

Table II (a)

Identification of Non-Poisonous from Poisonous Snakes

Non-Poisonous

1. Scales on the body imbricate, i.e., semi-circular (*Fig. 11-1*) No proper distinction between dorsal and scales. Tail blunt, eyes vestigial ... **Typhlopidae** Blind snakes
2. Scales on the body clear, the ventral scales running across the belly. Eyes present.
   (a) Ventral scales not completely across the belly (*Fig. 11-2*). Rough tails... **Uropeltidae** *Uropeltis ocellotus*
      (*i*) Tail end blunt (*Plate. 30-d*), ... **Boidae** Sand boa

(*ii*) Tail end blunt but not rough *Eryx conicus*
... ... *Eryx johnii*

(*iii*) Tail elongate with spurs near vent ... ... *Python molurus*

(b) Ventral scales completely across the belly (*Fig. 11-3*). Nostrils usually lateral, head covered with large symmetrical shields, Hypophyses absent or present on the posterior dorsal vertebrae. Teeth solid ... **Colubridae** All Colubrid snakes

(c) Ventral scales completely across the belly. Head shields present in which loreal may be absent. Tail cylindrical except in sea snakes. Hypophyses developed through-out the vertebral column. Few teeth modified to form fangs followed by solid teeth **Poisonous** ... **Hydrophiidae Elapidae, and Viperidae** (*see 3 below*)

3. (Those in 2c)

(a) Ventral scales not completely across the belly. Tail flattened or modified to form an oar-like structure (*Plate 30-b-c*). The ventral scales modified (*Fig. 30-c*) to form ventral ridge. Eyes at the anteriormost end of head. Poison fangs present

(b) Ventral scales completely across the belly. Tail elongate. Head shields well developed. Head oblong or elongate. Poison fangs small in front of jaw, not erectile and not covered by a sheath ... **Elapidae**

(*i*) Central row of dorsal scales hexagonal (*Fig. 12-1*); and caudal scales in a single row

(*Fig. 10-V*). Body steel blue with white cross bars or white cross spots ... Common Krait *Bungarus caeruleus*

Body yellow with black cross bands and a black stripe across the face ... Banded Krait *Bungarus fasciatus*

(*ii*) Central row of dorsal scales of the same type, rhomboid or elliptical and with some distance in between them. Head not triangular. Head shields well developed. Fangs neither erectile nor covered by a sheath.

(*iii*) Hood present. Eyes with a round pupil. Frontal shield truncate. Three small postocular scales behind the eye. Seven supralabials of which third is biggest and is touching the eye and the nasal scale. A tiny triangular shield between fourth and fifth infralabial (*Fig. 10-IV*). The caudal scales in pairs (*Fig. 11-4*). Apart from the binocellate or monocellate mark on the hood, two or three series of black bands on the ventral surface of the hood between 10th and 17th series of transverse scales. Between 15th and 30th ventral scales a pair of round black mark extending from 4 to 6 scales Plate 37. *Cobra* *Naja naja*

(*iv*) Frontal shield not truncate anteriorly. No triangular

shield between fourth and fifth infralabials. The presence of two large occipital shields (*Fig. 10-L*) beyond parietal. Caudal scales near vent are single and beyond are divided. Poison fangs present. Hood with yellow cross bars dorsally and two black bands and corner black spots ventrally Plate 39. Body olivaceous along with cross bars. — King Cobra *Naja Hannah*

(*v*) Hood absent. Body slender. Two postocular. Six supralabials, third and fourth touching the eye. Three or four teeth behind the poison fangs. Small snakes, light brown or reddish with black spots or stripes even on the head. — Coral snake *Callophis melanurus (Fig. 11)*

(c) Ventral scales across the body. Tail elongate. Head shields tiny. Head triangular (*Fig. 10-V*). Poison fangs big erectile, canaliculate and covered by a sheath. Eyes with vertical pupils (*Fig. 1*).

Viperidae

(*i*) Dorsal body scales oblong with central longitudinal (*Fig. 12-3*) ridge and with three rows of elliptical spots (*Plate 41*) on the body. Big size ... *Russell's viper*

(*ii*) Dorsal body scales at the sides serrated (*Fig. 12-6*), (*Plate 18*). Head with an arrow (*Plate 38-a*) mark. Body covered by brown rows of patches. Movement by side

winding. The serrated scales make a continuous sound. Small snakes not more than 18 inches in length. Fangs erectile and covered by a sheath ... ... *Echis carinatus*

(*iii*) A pit beyond the nasal between preocular and loreal (*Plate 26*). Eyes with a vertical pupil. Scales on body keeled. Tip of head raised in the rostral region. Fangs erectile, covered by a sheath. ... *Pit vipers*

TABLE II (b)

I. WORM LIKE BODY

Eyes vestigial.

1. Entire body covered by uniform imbricate scales.
2. Tail very short and stumpy.
3. Teeth on one jaw only.
4. Some vestiges of pelvic bones present inside the body.
5. Palato-maxillary arch not complete.
6. Prefrontal bone forming a stature with nasal.

(a) 1. Teeth only in upper jaw.
2. 16-36 scales round the body... **Typhlopidae**

(b) 1. Teeth only in lower jaw.
2. 14 scales round the body **Leptotyphlopidae**

II. SNAKE LIKE BODY.

Eyes exposed.

1. There is a distinction between dorsal and ventral scales.
2. Tail tapering and long.
3. Teeth on both jaws.

4. Some vestiges of hind limbs seen outside the body.
5. Palato-maxillary arch complete.
6. Prefrontal in contact with nasal.

(a) (*i*) Vestiges of hind limbs present

1. Ventral scales narrower than the adjacent scales but not distinct.
2. Body covered by 19-23 scales **Anilidae**

(*ii*) 1. Ventral scales broader than adjacent scale. More than 40 scales round the body.

2. Vestiges of hind limbs terminating in a claw like spur, seen on each side of the vent **Boidae**

(b) No vestiges of hind limbs

1. Bones of the skull united.
2. Prefrontal in contact with nasal.
3. Ventral scales well developed.
4. Premaxillary teeth present.

A. No poison fangs in front of jaw.

(*a*) Ventral scales well developed but not extending across the belly.

1. Ventral scales scarcely broader than adjacent scales.
2. Tail extremely short ending obtusely and covered with modified scales. **Uropeltidae**

OR

1. Ventral scales equal to or broader than adjacent scales.
2. Tail longer.
3. Premaxillary teeth present.
4. An azygous occipital shield in contact with frontal. **Xenopeltidae**

(*b*) Ventral scales extending across the belly.

Table II (c)

Classification up to Family

SNAKES

1. Worm like body.
2. Eyes vestigial.
3. Entire body covered by uniform imbricate scales.
4. Tail very short and stumpy.
5. Teeth on one jaw only.
6. Some vestiges of pelvic bones present inside the body.
7. Palato-maxillary arch not complete.
8. Prefrontal bone forming a suture with nasal.

1. Teeth only in upper jaw.
2. 16-36 scales round the body.

TYPHLOPIDAE

1. Teeth only in lower jaw.
2. 14 scales round the body.

LEPTOTYPHLOPIDAE

1. Snake like body
2. Eyes exposed.
3. There is a distinction between dorsal and ventral scales.
4. Tail tapering and long.
5. Teeth on both the jaws.
6. Some vestiges of hind limbs seen outside the body.
7. Palato-maxillary arch complete.
8. Prefrontal in contact with nasal.

Vestiges of hind limbs present

1. Ventral scales narrower than adjacent scales but not distinct.
2. Body covered round by 19–23 scales.
   No claw.
   No spur.

ANILIDAE

1. Ventral scales broader than adjacent scales
2. More than 40 scales round the body.
3. Vestiges of hind limbs terminating in a claw like spur, seen on each side of the vent.

BOIDAE

No vestiges of hind limbs

1. Bones of skull united.
2. Prefrontal in contact with nasal
3. Ventral scales well developed.
4. Premaxillary teeth present.

Poison fangs in front of jaw.
The anterior maxillary tubular or canaliculate.

No poison fangs in front of jaw.

Tail compressed vertically (paddle shaped).
Maxillary bone horizontal with teeth in front of the fangs.
Pupil round.
HYDROPHIIDAE

1. Tail cylindrical.
2. Ventral scales nearly as broad as the belly.
3. Maxillary bone horizontal with teeth behind the fangs.

1. Pupil round.
2. Fangs tubular bare.
ELAPIDAE

1. Maxillary bone very short, vertically erectile bearing bare fangs only.
2. No teeth on maxillary bone except poison fangs.
3. Pupil vertical.
4. Fangs canaliculate and covered by a sheath.
VIPERIDAE

Ventral scales well developed but not extending across the belly.

1. Ventral scales scarcely broader than adjacent scales.
2. Tail extremely short ending obtusely and covered with modified scales.
P. M. teeth absent.
UROPELTIDAE

Ventral scales extending across the belly.

1. Ventral scales equal or broader than adjacent scales.
2. Tail longer
3. Premaxillary teeth present. An azygous occipital shield in contact with frontal.
XENOPELTIDAE

1. Scales of the body in 15 rows.
2. Maxillary bone edentulous except for a few minute teeth. Tail blunt or flat.
3. Pupil vertical.
4. Hypophyses of anterior vertebrae piercing oesophagus.
DASYPELTIDAE

1. Scales in more than 15 rows.
2. Teeth in both the jaws.
3. Prefrontal in contact with nasal.
4. Pupil round or vertical.
5. Tail cylindrical and pointed.
COLUBRIDAE

(*i*) 1. Scales of the body in 15 rows.
2. Maxillary bone edentulous except for a few minute teeth.
3. Pupil vertical.
4. Hypophyses of anterior vertebrae piercing oesophagus **Dasyplitidae**

(*ii*) 1. Scales in more than 15 rows.
2. Teeth in both jaws.
3. Prefrontal in contact with nasal.
4. Pupil round or vertical.
5. Tail cylindrical and pointed . **Colubridae**

B. Poison fangs in front of jaw.

(*a*) (*i*) The anterior maxillary teeth tubular. Fangs tubular.
1. Tail compressed vertically (paddle shaped).
2. Pupil round.
3. Maxillary bone horizontal with teeth behind the fangs. ... **Hydrophiidae**

(*ii*) 1. Tail cylindrical.
2. Ventral scales nearly as broad as belly.
3. Pupil round.
4. Fangs tubular in front. ... **Elapidae**

(*b*) Fangs canaliculate.
1. Pupil vertical. Tail cylindrical.
2. Maxillary bone very short, vertically erectile bearing fangs only.
3. No teeth on maxillary bone except poison fangs.
4. Fangs canaliculate. ... **Viperidae**

TABLE III

Distribution of different species of snakes recorded in India[1]

Order:	Squamata.	
Sub-order:	Serpents.	
Family:	**Typhlopidae**	
Genus:	*Typhlops:*	
Species:	*porrectus*	Himalayas, Punjab, Bihar, U.P., Orissa, Bengal, Maharashtra, Mysore, Kerala.
	braminus	All over India.
	psammeces	Tamil Nadu.
	thrustoni	Nilgiris, Kerala.
	jerdoni	Eastern Himalayas, Assam
	tenuicollis	Assam.
	diardi	Bengal and Assam.
	oatesi	Range not clearly known as single specimen recovered.
	bothriorhynchus	Assam.
	tindalli	Kerala.
	beddomei	Kerala, Annamalai Hills.
	oligolepis	Sikkim, Darjeeling.
	andamanesis	Andaman Islands.
	acutus	South of Ganges basin and South of Rajasthan, West of Baroda and East of Calcutta.
Family:	**Leptotyphlopidae**	
Genus:	Leptotyphlops:	
Species:	*macrorhynchus*	(not in India).
	blanfordi	(not in India).
Family:	**Uropeltidae**	
Genus:	Melanophidium:	
Species:	*punctatum*	Kerala, Annamalai Hills, Telewady at Goa border.

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[1]Smith (1943). India was partitioned in 1947 and the States were reorganised in 1956. Some of the places are now in Pakistan. Also there have been some changes in the names of places, such as, Bombay (*now* Maharashtra), C.P. (*now* Madhya Pradesh), Rajputana (*now* Rajasthan) and Travancore (*now* Kerala) referred to in the above table.

	bilineatum	Tirrhibot Peaks, West of Manantoddy (Coorg).
	wynaudense	Manatoddy dist. (Coorg), 3,000-5,000 ft. height.
Genus:	*Platyplecurus:*	
Species:	*trilineatus*	Annamalai Hills and Kerala.
		madurensis Palni and Travancor Hills, 4000-6,000 ft. height.
Genus:	*Teretrurus:*	
Species:	*sanguineus*	Wynaad, Annamalai Hills, Kerala, 4,000-7000 ft. height.
	rhodogaster	Palni Hills (South India)
Genus:	*Plecturus:*	
Species:	*perroteti*	Nilgiris, Annamalai Hills, 4,500-6,000 ft. height.
	guentheri	Sispara ghats on the western side of Nilgiri Hills.
	aureus	Chambara Hills, Kerala.
	canaricus:	Mysore, 6,000 feet.
Genus:	*Uropeltis*	
Species:	*nitidus*	Annamalai hills.
	ocellatus	Western Ghats, Nilgiris, Annamalai Hills.
	dindigalensis	Madura.
	beddomei	Annamalai Hills.
	macrorhynchus	Annamalai Hills.
	wood-masoni	Travancore, Tinnevelly, Nilgiris, Palni Hills.
	macrolepis	Mahabaleshwar Hills.
	ceylonicus	Travancore Hills.
	arcticeps	Palghat, Tinnevelly Hills, Western Ghats, Travancore Hills.
	rubromaculatus	Nilgiri Hills.
	rubrolineatus	Western Ghats, Travancore Hills.
	phipsoni	Western Ghats, Annamalai Hills.
	myhendrae	Western Ghats.
	broughami	Palni Hills, Simmalai Hills,

		Nilgiris, Madura.
	maculatus	South India, Nilgiris, Annamalai Hills, 4,000-5,000 feet.
	petersi	Annamalai Hills, 4,000-5,000 feet.
	liura	Madura and Tinnevelly Hills, 3,000-5,000 feet.
	pulneyensis	Palni and Travancore Hills, Madura district, 5,000-7,000 feet.
	smithi	Annamalai Hills, 4,000-4,700 feet
	melanogaster	Hills of Central Province.
Genus:	*Rhinophis:*	
Species:	*sanguineus*	Mysore, Wynaad, Nilgiris, Travancore, Tinnevelly.
	travancoricus	Trivandrum, Pirmed, Ernaculam upto 4,000 feet.
Family:	**Xenopeltidae**	
Genus:	*Xenopeltis*	
Species	*unicolor*	Andamans
Family:	**Boidae**	
Genus	*Python*	
Species	*molurus*	All over India.
	retienlatus	Ratanpur. M.P.
Genus:	Eryx	
Species	*conicus*	All over India and Nainital area of Himalayas.
	johnii	Rajasthan, Uttar Pradesh, Punjab, Western India.
Family:	**Colubridae**	
Sub-Family:	Dipsadinae	
Genus:	*Pareas:*	
Species:	*macularius*	Gopaldhara and Darjeeling districts of Bengal.
	monticola	Eastern Himalayas, Sikkim, Darjeeling district, Assam.
Sub-Family:	Xenoderminae	
Genus:	*Stoliczkaia:*	
Species:	*khasiensis*	Khasi hills of Assam.
Sub-Family:	Acrochordinae	

Genus:	*Acrochordus:*	
Species:	*granulatus*	Coasts of India as far as Bombay.
Sub-Family: Colubrinae		
Genus:	*Elaphe:*	
Species:	*prasina*	
(Green tree racer)	*frenata*	From Darjeeling to Assam, Khasi Hills.
	oxycephala	Andaman and Nicobar Islands.
	radiata	Orissa and Eastern Himalayas.
	flavolineata	Andaman Islands.
	helena	Peninsular India to Sind, Himalayas, Assam.
	taeniura	Darjeeling.
	hodgsoni	Himalayas from Laddakh and Kashmir to Sikkim and Assam.
	cantoris	Eastern Himalayas, Assam.
Genus:	*Ptyas:* (Rat snake)	
Species:	*mucosus*	
(Dhaman)		All over India.
Genus:	*Zaocys:*	
Species:	*nigromarginatus*	Nepal, Sikkim, Darjeeling and Assam Hills upto 7,000 feet.
Genus:	*Coluber:*	
Species:	*ventromaculatus*	North Western India (Almorah in U.P. and Khandesh in Maharashtra).
	rhodorhachis	North West India.
	fasciolatus	Peninsular India extending North West upto Baroda through Gwalior to the Himalayas South of Nepal and Western Bengal.
	gracilis	Neighbourhood of Bombay, Madhya Pradesh (Asirgarh).
	diadema	Gilgit, U.P.
	arenarius	Rajasthan.
Genus:	*Opheodrys:*	
Species:	*doriae*	Assam.
Genus:	*Liopeltis:*	

Species:	*frenatus*	Assam Hills.
	stoliczkae	Sikkim, Darjeeling and Assam (Hills)
	calamaria	Western Ghats upto Matheran.
	rappi	Simla, Darjeeling and Nepal.
Genus:	*Coronella:*	
Species:	*brachyura*	Northern India, Pune (A rare snake).
Genus:	*Oligodon:*	
Species:	*cyclurus*	North Eastern India.
	juglandifer	Eastern Himalayas (Darjeeling)
	albocinctus	Assam, Sikkim, Bengal.
	theobaldi	Assam (Tura and Garo Hills).
	venustus	Western Ghats, South of Goa, Nilgiris, Palni and Travancore.
	travancoricus	Western Ghats, Travancore and Tinnevelly Hills.
	wood-masoni	Andaman and Nicobar Islands.
	taeniolatus	Whole of Peninsular India from Sind to Bengal.
	arnensis	Peninsular India to Sind.
	affinis	Western Ghats, South of Goa (Wynaad to Travancore).
	brevicauda	Western Ghats south of Goadan gap.
	erythrogaster	Eastern Himalayas, Nepal, Darjeeling.
	dorsalis	Assam, Bengal.
Genus:	Ahaetulla:	
Species:	*ahaetulla*	Bengal and Eastern Himalayas.
	cyanochloris	Bengal, Assam.
	grandoculis	Western Ghats, Travancore, Tinnevelly, Nilgiri Hills and Wynaad.
	gorei	Darjeeling, Assam.
	bifrenalis	Southern India, Trivandrum and Travancore.
	caudolineolata	Southern India, Ramnad and Travancore.
	tristis	Peninsular India as far as Sind border in the North-West and Darjeeling in the North-East.

Genus:	Chrysopelea:	
Species:	*ornata*	Darjeeling, Bihar and Orissa.
	paradisi	Andaman Islands.
Genus:	*Lycodon:*	
Species:	*travancoricus*	Western Ghats to Matheran. Also at Arcot, Vizagapattam in Eastern Ghats, M.P., Nilgiris.
	jara	Madras, Bengal and Assam.
	flavomaculatus	Nasik, Lonavala, Deolali and other parts of Maharashtra.
	mackinnoni	Mussoorie, Almorah, Nainital.
	aulicus	All over India (common wolf snake).
	fasciatus	Eastern Himalayas, Assam.
Genus:	*Dinodon:*	
Species:	*septentrionalis*	Darjeeling, Assam.
	gammiei	Sikkim and Darjeeling Districts.
Genus:	*Dryocalamus:*	
Species:	*nympha*	Western, Southern India and Orissa.
	gracilis	Peninsular India (Annamalai Hills, Cudapah Hills), Orissa.
Genus:	*Sibynophis:*	
Species:	*collaris*	Simla and Assam.
	subpunctatus	Matheran, Nasik, Bengal, M.P.
	saggitarius	Madhya Pradesh and Uttar Pradesh, Western Bengal and Western Himalayas.
Genus:	*Natix:*	
Species:	*parallela*	Sikkim, Assam.
	nicobarensis	Nicobar Islands.
	khasiensis	Khasi and Garo Hills in Assam.
	xenura	Cherrapunji in Khasi Hills and Assam.
	piscator	North West and Madhya Pradesh.
	himalayana	Eastern Himalayas as far west as Sikkim.
	stolata	All over India.

	platyceps	Himalayas from Kashmir in the west to Assam in the east 5,000-6,000 feet.
	beddomei	Western Ghats south of Mahabaleshwar, Nilgiris, 3,000-7,000 ft.
	monticola	Western Ghats from Telewadi to Travancore.
Genus:	*Pseudoxenodon:*	
Species:	*macrops*	Nepal, Assam.
Genus:	*Macropisthodon:*	
Species:	*plumbicolor*	All over India except Ganges Valley and the extreme North West.
Genus:	*Xenochrophis:*	
Species:	*ceratogaster*	U.P., Bengal, Assam.
Genus:	*Atretium:*	
Species:	*schistosum*	Annamalai Hills, Wynaad, Mysore, U.P., Orissa.
Genus:	*Trachischium:*	
Species:	*monticola*	Assam Hills.
	fuscum	U.P. and Assam (Hilly regions 5,000-7,000 ft.).
	guentheri	Sikkim, Bengal between 3,000-7,000 ft.
	tenuiceps	Nepal, Sikkim, Bengal.
	laeva	Western Himalayas.
Genus:	*Rhahodops:*	
Species:	*olivaceus*	Western Ghats (Wynaad).
	bicolor	Assam.
Genus:	*Blythia:*	
Species:	*reticulata*	Hills North and South of Brahmaputra to Manipur in Assam.
Genus:	*Xylophis:*	
Species:	*perroteti*	Western Ghats (Wynaad to Tinnevelly).
	stenorhynchus	Western Ghats (Annamalai Hills to Tinnevelly).
Genus:	*Boiga:* (Cat snake)	

Species:	*multimaculata*	Assam (Sylhet).
	ochracea	Eastern Himalayas, Assam and Nicobar Islands.
	trigonata	Whole of Peninsular India, Western and Eastern Himalayas, Sikkim, Bengal.
	gokool	Eastern Himalayas, Darjeeling, Assam.
	ceylonensis	Western Ghats.
	quincunciata	Assam.
	cyanea	Darjeeling, Assam.
	multifasciata	Western Himalayas and Easten Himalayas.
	cynodon	Bengal and Assam.
	forsteni	Peninsular India, Western Ghats, Ganges Valley, Orissa.
	dightoni	Travancore.
Genus:	*Psammophis:*	
Species:	*schokari*	Rajasthan, Punjab, Kashmir.
	condanarus	Cutch, Punjab, Central India, U.P., Bihar, Orissa, Bengal.
	longifrons	Bombay, M.P.
	leithi	Bombay, Rajasthan, U.P., Punjab, Kashmir.
Genus:	*Psammodynastes:*	
Species:	*pulverulentus*	Eastern Himalayas upto Nepal.
Genus:	*Dryophis:*	
Species:	*dispar*	Western Ghats, (Nilgiris and North Canara) at 5,000 ft.
	fronticinctus	Assam and Darjeeling.
	nasutus	Penisular India, Bengal.
	prasinus	Bengal, Sikkim and other parts of the Eastern Himalayas.
	pulverulentus	Western Ghats.
	perroteti	Western Ghats, Nilgiris.
Sub-Family:	Homalopsinae *(Fresh water snakes)*	
Genus:	*Enhydris:*	
Species:	*enhydris*	U.P., Bihar, Bengal, Assam and Orissa.

	sieboldi	Travancore, Bombay, Delhi, Agra, Bihar, Assam.
Genus:	*Cerberus:*	
Species:	*rhynchops*	Coast and tidal rivers of India from Bombay to Cochin.
Genus:	*Gerardia:*	
Species:	*prevostiana*	Coastal and tidal rivers of Bombay and Malabar Districts.
Genus:	*Fordonia:*	
Species:	*leucobalia*	Bengal.
Family:	**Dasypeltidae**	
Genus:	*Elachistodon:* (Indian egg eater)	
Species:	*westermanni*	Northern Bengal and Bihar.
Family:	**Elapidae**	
Genus:	*Bungarus:* (Kraits)	
Species:	*bungaroides*	Eastern Himalayas, Assam.
	fasciatus (Banded Krait)	North East India, U.P.,M.P., Bihar and Orissa.
	caeruleus (Common Indian Krait)	All over India except Kashmir at North, Bengal, Assam at East and below Hyderabad in the South Tripura.
	niger (Black Krait)	Darjeeling, Assam.
	lividus	Bengal and Assam.
	walli	U.P., Bengal, Bihar and Orissa.
Genus:	*Callophis:*	
Species:	*melanurus*	Bombar, Malabar, Dharwar, Coimbatore, Annamalais, Bengal and M.P. Dhar.
	nigrescens	Nilgiris, Annamalais, Travancore, Panchgani-Mahabaleshwar.
	beddomei	Shevaroy Hills of Mysore.
	macclellandi (Coral snake)	Assam and Darjeeling.
	bibroni	Western Ghats as south as Coorg.

Genus:	*Naja* (Cobra):	
Species:	*naja*	Peninsular India.
	oxiana	Punjab and Kashmir.
	kaouthia	Bengal and Eastern Himalayas.
	hannah	Peninsular India to Himalayas,
	(King Cobra)	Orissa, Bengal.
Family:	**Hydrophiidae**	
	(Sea snakes)	
Genus:	*Lacticauda:*	
Species:	*laticaudata*	Bay of Bengal.
	colubrina	Andaman and Nicobar Islands water.
Genus:	*Kerilia:*	
Species:	*jerdoni*	East coast of Indian Peninsula.
Genus:	*Praescutata:*	
Species:	*viperina*	(completely banded from India) Karwar waters (Only one specimen from India).
Genus:	*Enhydrina:*	
Species:	*schistosa*	(From the Persian Gulf to the North coast of Australia.)
Genus:	*Hydrophis:*	
Species:	*nigrocinctus*	Bay of Bengal.
	spiralis	(From the Persian Gulf to Malayan Peninsula.)
	cyanocinctus	West coast of Indian Peninsula.
	obscurus	East coast of India.
	stricticollis	East coast of India, North of Orissa.
	ornatus ornatus	From the Persian Gulf to China.
	lapemoides	Western and Eastern coasts of India.
	mamillaris	Coasts of India, Gulf of Cambay, Bombay and Vizagapattnam.
	caerulescens	Bombay and Karwar on the Western coast and from Madras to the mouth of Ganges on the Eastern coast.
	fasciatus	Coasts of India on Eastern side, rare on the Western coast of

		the India Peninsular Region.
Genus:	*Lapemis:*	
Species:	*curtus*	West coast of Peninsular India.
Genus:	*Microcephalophis:*	
Species:	*gracilis*	From the Persian Gulf to coast of Australia.
	cantoris	West coast of India to Cannanore and on east from Orissa, Chittagong.
Genus:	*Pelamis:*	*(Most widely distributed of the sea snakes):*
Species:	*platurus*	Common in Indo-Australian waters and hundreds of miles from the coast.
Family:	**Viperidae** Vipers	
Sub-Family:	Viperinae	
Genus:	*Vipera:*	
Species:	*russelli* (Russell's viper)	All over India from Ceylon to Himalayas in plains as well as upto the height of 7,000 ft.
	labitina	Kashmir
Genus:	*Echis:*	
Species:	*carinatus* (Saw-scaled viper)	All over India, South of Ganges except Bengal, Kashmir.
Genus:	*Pseudocerastes:* (Horned vipers):	
Species:	*persicus*	(Sometimes in N.W.F.P. only.)
Sub-Family:	Crotalinae	
Genus:	*Ancistrodon* (Pit vipers):	
Species:	*himalayanus*	Western Himalayas from Chitral to Sikkim, Khasi Hills in Assam.
	hypnale (Hump nosed viper)	Western Ghats as North as latitude 16°, i.e., upto Goa.

Genus:	*Trimeresurus:* (Pit vipers):	
Species:	*macrolepis*	Southern India Hills, Nilgiris, Annamalai Hills, Travancore.
	mucrosquamatus	Naga Hills.
	monticola	Eastern Himalayas as far west as Nepal.
	jerdoni	Khasi Hills, Assam.
	malabaricus	Hills of Western and Southern India varying from 2,000-7,000 ft. (Mahabaleshwar, Goa, N. Canara, Coorg, Nilgiris, Annamalai Hills, Palni and Travancore Hills).
	strigatus	Southern India between 3,000-6,000 ft. (Nilgiris, Annamalai Hills and Palni Hills).
	gramineus (Bamboo pit viper)	Peninsular India, South of Hyderabad, common at coastal rocks, N. Canara district, Lonavala.
	stejnegeri	Darjeeling, Assam, Shillong and other Eastern Himalayan Regions.
	popeorum	Eastern Himalayan Regions.
	cantori	Nicobar Islands.
	purpureomaculatus andersoni	Exclusively from Andaman Islands.
	erythrurus	Bengal, Assam and other parts of the Eastern Himalayas.
	albolabris	Punjab, M.P., Nepal.
	labialis	Only from Nicobar.

NON-POISONOUS SNAKES

FAMILY : TYPHLOPIDAF

Typhlops Braminus

THE COMMON BLIND SNAKE

Hindi : *Andha Samp*
Bengali : *Phen Samp*
Gujarati : *Bandhani chakan*
Malayalam : *Kurudi pambu*
Marathi: *Danav, Kadu*

Distribution : All over India.
Length : 170 – 180 mm

This blind degenerate snake is brown with a shining chocolate hue above, lighter below and the head and tail region are slightly whitish. It is found in rotting vegetation and is sometimes recovered from bathrooms in rural homes. They represent primitive snakes and are found in semitropical and tropical regions. They are sometimes found in bathrooms adjoining gardens of single-storied houses.

These snakes look like earthworms, but they have a much darker colour and have imbricate scales all over the body. There is no distinction between dorsal and ventral scales. The earthworm has circular rings round the body. There are 20 scales round the body. There are 300 – 320 rows of transverse scales (*Plate 32*).

The head is not distinct from the body. The tail-end is blunt with a small point. They burrow rapidly in soft earth. Their movements on the ground are slow, while in soft earth many of them stick a spine or point of their tail in ground and progress forward with a jerk. They make burrows below grass, and keep opening and shutting the mouth, as if to bite.

These snakes feed on worms, soft bodied insects and their larvae. There are a few teeth in the upper jaw only. In the head region bones are not properly ossified. Mahendra[1] and Mookerjee and Das[2] mention that the parietal bone in these snakes is paired. These snakes have large rostral, nasal, ocular and preocular shields on the head. Nasal shields are completely divided into an anterior lower and a posterior upper portion, the cleft passing through the nostril. The eyes are tiny, more or less covered by scales. Sebaceous glands are present on the body.

The snakes are usually oviparous.

FAMILY : UROPELTIDAE

Uropeltis Ocellatus

Distribution : Western Ghats upto the Nilgiris and in Maharashtra.
Malayalam : *Chemvallayam Pambu*
Length : 540 mm.
Thickness: 25 mm.

Different species of this snake are to be found in different parts of India. They differ in colouration and pattern, but all have got roughness of tail as the common characteristic along with their habitat at higher altitudes. The details of distribution are given under Table III. The scalation is primitive and the differentiation between dorsal and ventral scales is sharp along with proper head scales. The ventrals nevertheless are small and do not cover the entire belly area.

Both the ends of this snake are blunt. The mouth end is slightly tapering. The tail end is blunt but at the tip the scales are making it rough and the tail becomes as if flatly blunt. Because of the roughness of the scales in the tail, the snakes are called rough-tailed (*Plate. 30-a*).

Eyes are present, they range in size from one-fifth to one-third of the length of the ocular shield.

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[1]Mahendra (1936).
[2]Mookerjee and Dass (1932).

This snake is thicker than the human thumb and is chocolate brown with yellow and red spots on the body. It feeds on insects, larvae and is normally seen moving through soil and decaying vegetation. It makes an effort to burrow in soil and sometimes lashes the rough pointed tail. It is a non-poisonous snake which often shuns light, but the colouration it shows in movement often betrays the animal. The snake is viviparous, *i.e.*, laying young ones directly.

FAMILY : BOIDAE

Python Molurus

INDIAN PYTHON

Hindi
Gujarati } : *Ajgar*
Marathi }
Malayalam : *Malam Pambu*
Tamil : *Priya Pambu*
Bengali : *Mayal*

Distribution : Throughout India, particularly in rocky wet regions near bushes.

Length : 7,000 mm as a maximum. The maximum girth at the thickest is about 900 mm.

The head scales are prominent. There are 11 to 13 supralabials. The first two are full of pits, the sixth and the seventh touching the eye or partly separated by suboculars. The infralabials are from 16 to 18; the anterior ones are long and narrow and the posterior ones partiy pitted. Parietal, loreal and temporal regions are covered with irregular scales (*Plate.I col.*). The rostral scale on the head bears a deep pit on either side. The function of the pit is probably thermoreceptive.

The scales on the body are in 60 to 75 smooth rows, and the ventrals are distinctly smaller, body ending in a short tail. Just near the anal are two claw-like spurs which are rudiments of appendages. This is the only snake which exhibits these rudiments that could often inflict serious injuries. These appendages are about 45 mm long and about 20 mm at the thickest.

The rostral scale on the head bears a deep pit on either side. The function of the pit is probably sensory.

The snake is brown above (*Plate. II col.*) with rhomboid dark greyedged spots on the body. There is a lancet-shaped brown mark on the head and tapering pink brown stripes at the sides of the head extending beyond to the eyes. The ventral side is greyish with yellow and brown spots, more prominently seen in the tail region. After a fresh shedding of skin, the snake looks iridescent and when disturbed is heard to hiss quite loudly.

This is about the biggest and thickest snake of India. It weighs up to a maximum of 250 lb. Many a tale has been woven about its propensity to catch a prey by suction or its capacity to strangulate victims. In the *Mahabharata* it is stated that King Nala left his wife Damayanti in a jungle and that she was entwined by a huge python.

This snake is sometimes eaten and it is reported to have been used to feed the "Chindwin" expedition that went through Burmese jungles during the second World War. It lives in wet rocky regions and is a good climber. It is also a good swimmer. When on trees it lies motionless waiting for its victim. It kills by strangulation. It feeds on birds, reptiles and mammals. It is a lethargic snake but on sight of the prey it becomes very active, hurling its head at the body of the prey and strangulating the victim with the coils of its strong muscular body.

The other variety *P. reticulatus* first catches the head of the victim at the mouth-end, while *P. molurus* catches it anywhere on the body. After the death of the victim, the prey is gradually shoved inside the mouth while the snake lies for some time to rest. It also twines round tree-trunks probably to crush the bones of the victims. It has been observed to have crushed even a boar, while goats are often seen to have been killed. News item at Page 3 (3.8.1967) of *Loksatta* mentions that during the flood in the river Payee in Bassin near Bombay the villagers saw a python swallowing a goat in fifteen minutes and going up a banyan tree to twine probably to crush the bones.

During winter months, it hibernates. Immediately after the winter months, it lays about 107 eggs. It has a maternal

instinct in as much as the females remain coiled round the eggs probably to hatch. The eggs are said to hatch in about 60 days. The curator of the Ahmedabad Zoo had observed a python 16 feet long to lay 34 eggs in mid-May. The female sat continuously on the eggs and 28 eggs hatched in July.

The growth observed in the laboratory in Bombay has shown that the snake grew at the rate of six to eight inches per year, but one did not know how old it was when it came to the laboratory.

There is another python, *Python reticulatus*, which is thinner than *P. molurus*, but much longer. The author had seen one in 1930 in the deep forest at Ratanpur in Madhya Pradesh. It is perhaps the largest snake, attaining a length of 30 feet. No other authentic records of this snake in India are available. There is a difference in colouration and some scalation between these two pythons.

Eryx Conicus

SAND BOA

Hindi : *Dumuha*
Marathi : *Durkya Ghonas*
Kannada: *Netragodchi hawu*
Malayalam: *Manuli pambu*
Distribution : All over India.
Length : 480 mm in males and about double that length in females.

It is a pinkish grey snake with deep brown irregular patches all over the body. The patches are edged by black borders. The ventral side is faint yellow with brown spots on the outer sides.

The escalation on the head is very primitive. The head is not distinguishable from the neck. The eyes are very small with a vertical pupil. The nostril is like a slit. Only three scales on the head are enlarged and the rest of the head is covered by small raised scales. Ten to fifteen scales are present round the eye. Body scales are 40-55 in rows often keeled, particularly on the tail. The ventral scales do not run across the belly *(Fig. 11-2)*.

The snake remains hidden in sandy soils. It prefers to hide under soft surfaces where the body colour is in keeping with the surroundings. It feeds on frogs, mice, lizards, etc.

The snake could always be distinguished by its blunt rough tail which looks like the head end. The fact that it sometimes crawls back, it is mistaken to be a two-headed snake, having a head at either end (*Plate. III col).*

In the laboratory, I have observed it to be very vicious, striking on slightest touch and biting forcibly. It is often mistaken to be the young one of a python; but it can be distinguished from the latter by the shape of its tail, the small scales on the head, the colouration and the absence of the primitive appendages at the anal end (*Plate. 16-a).*

It is oviparous, laying eggs during summer months.

There is another sand boa very common in India, which is more docile than the above. This is chocolate in colour with a similar pattern of scales and shape of tail. It lies buried in soil and is called *Eryx Johnii* or John's sand boa. This snake is much longer than *Eryx conicus* and is also found all over India. It is called *Mandol* in Marathi.

FAMILY : COLUBRIDAE

Sub-family : Acrochordinae

Acrochorodus Granulatus

Wart Snake

Distribution : West coast of India, Nicobar Islands.
Length : 1,000 mm.

Dark grey with faint white cross bars or spots which are indistinct in the adult. Head chocolate with yellowish spots and full of small scales. The nasal opening is on the upper surface of the head. White bands run round the body. In fact, the snake appears greyish with dark bars across the body.

There are 100 scales round the body, partly covering each other and each scale having a central tubercle. On the underside there is a fold of skin in the centre. The fold contains small spinous scales.

Some authorities think that this snake is quite common in the coastal areas of India, chiefly in estuaries and may be collected by fishermen in nets. It does not move much on land

Plate I. COMMON INDIAN PYTHON
(*Python molurus*)

Plate II. INDIAN PYTHON ALONG WITH SAND BOAS
Left side—*Eryx johnii.* Right side—*Eryx conicu*

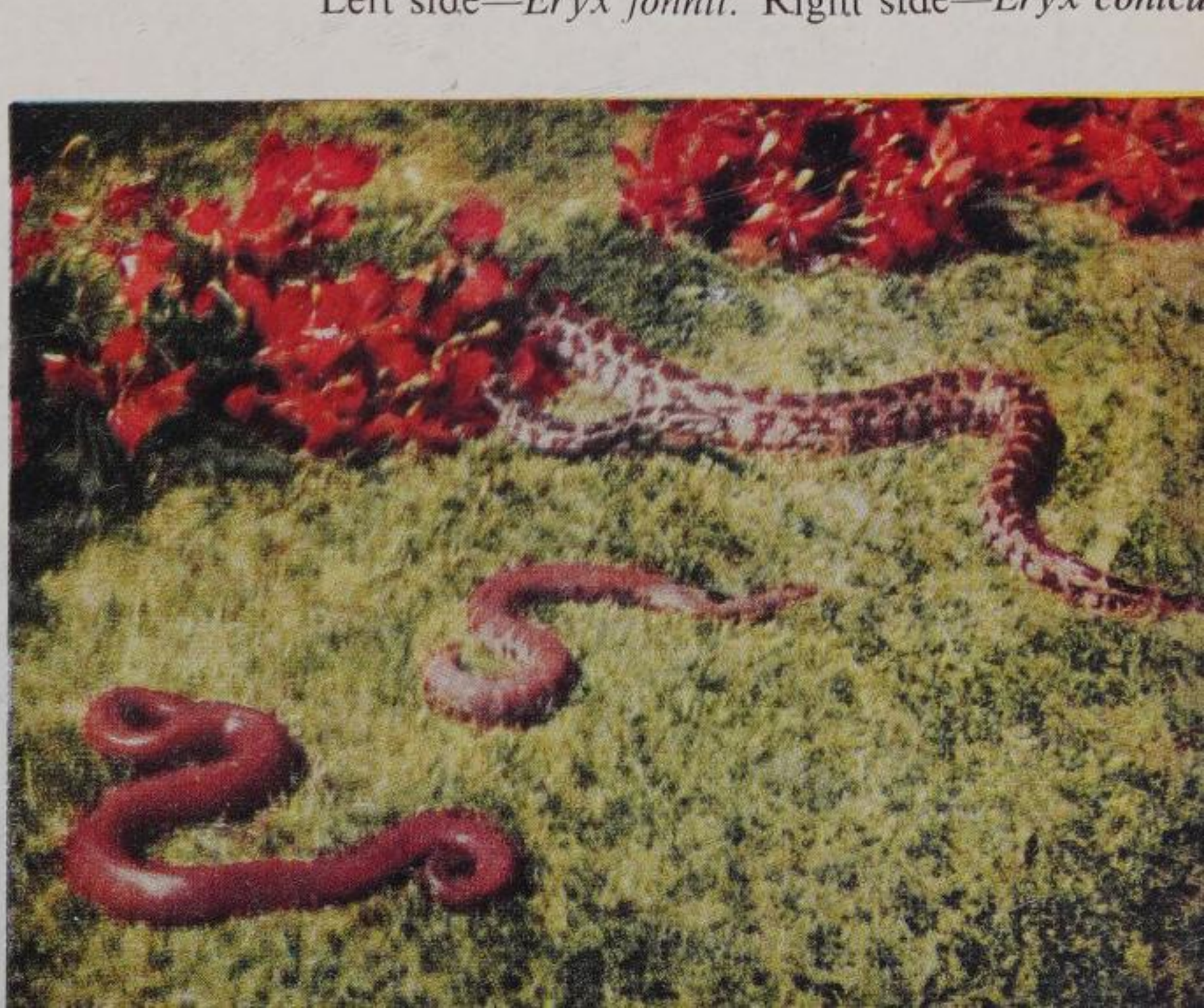


Plate III. SAND BOA (*Eryx conicus*)

Plate IV. THE RAT SNAKE (*Ptyas mucosus*) (About to strike)

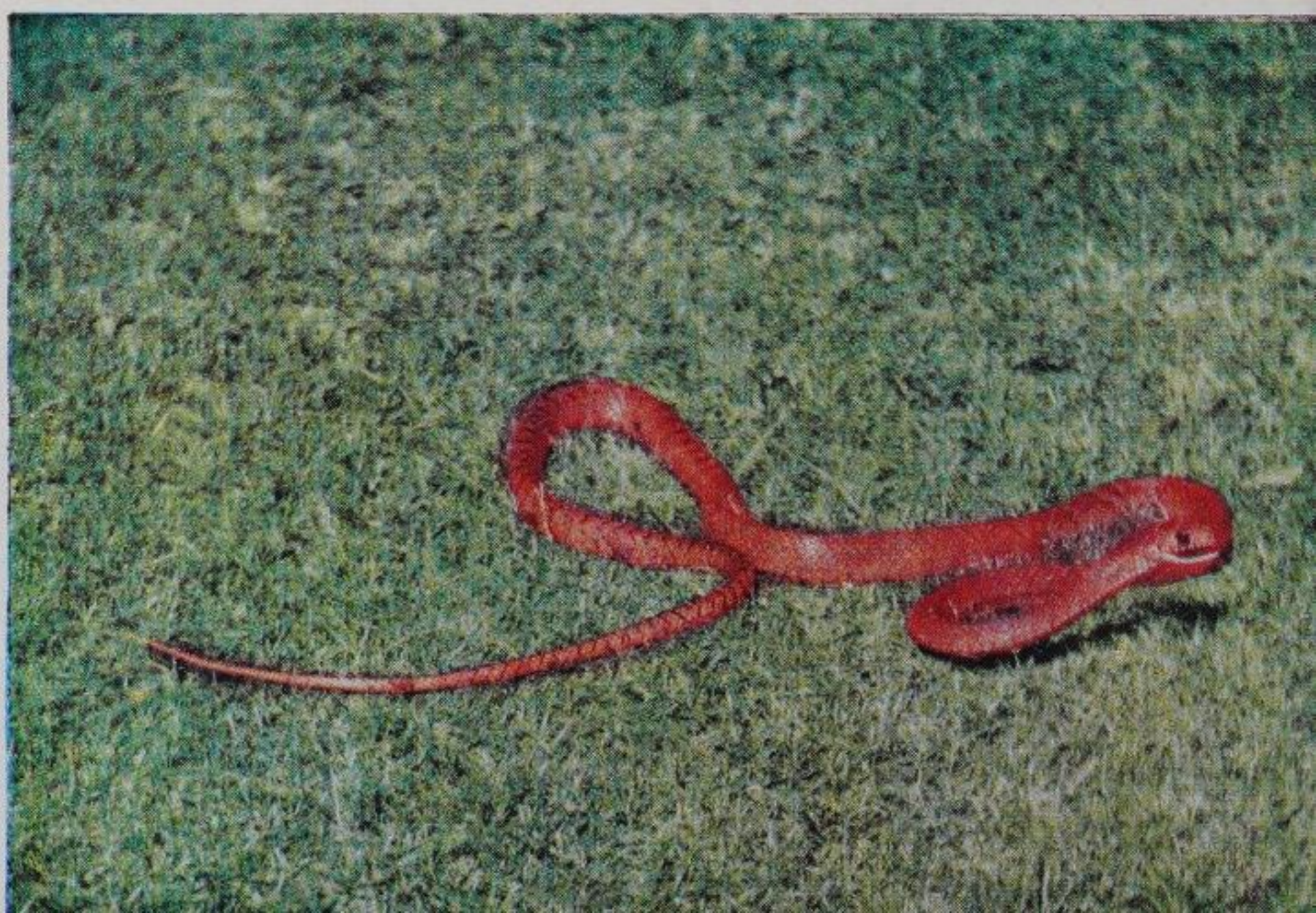


Plate V. DIADEM SNAKE (*Coluber diadema*)
AND A RUSSELL'S VIPER (*Vipera russelli*)

Plate VI. CHECKERED-KEEL-BACK
(*Natrix piscator*)

Plate VII(*a*). COBRA (*Naja naja*)
(Assuming an attitude before attack)

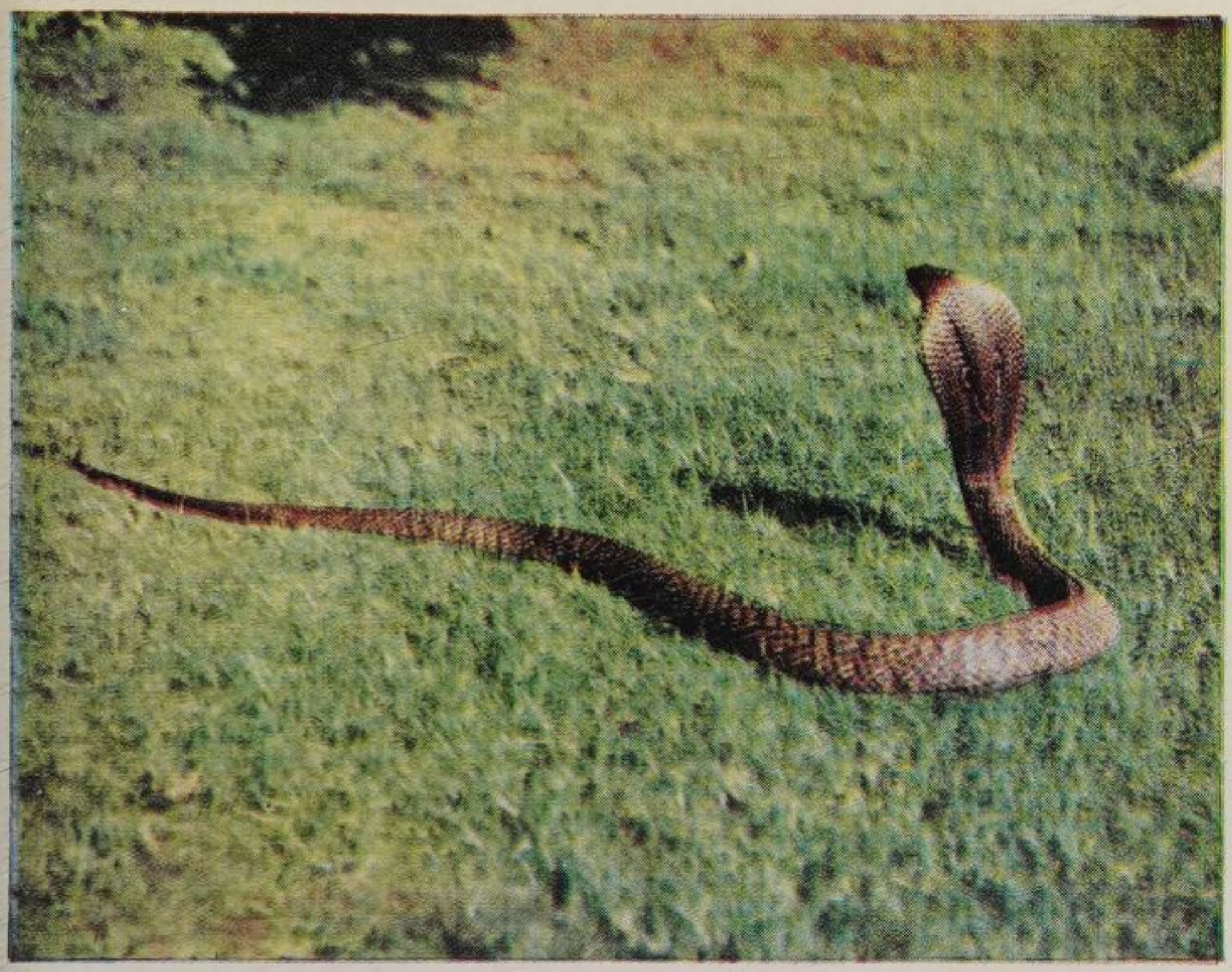
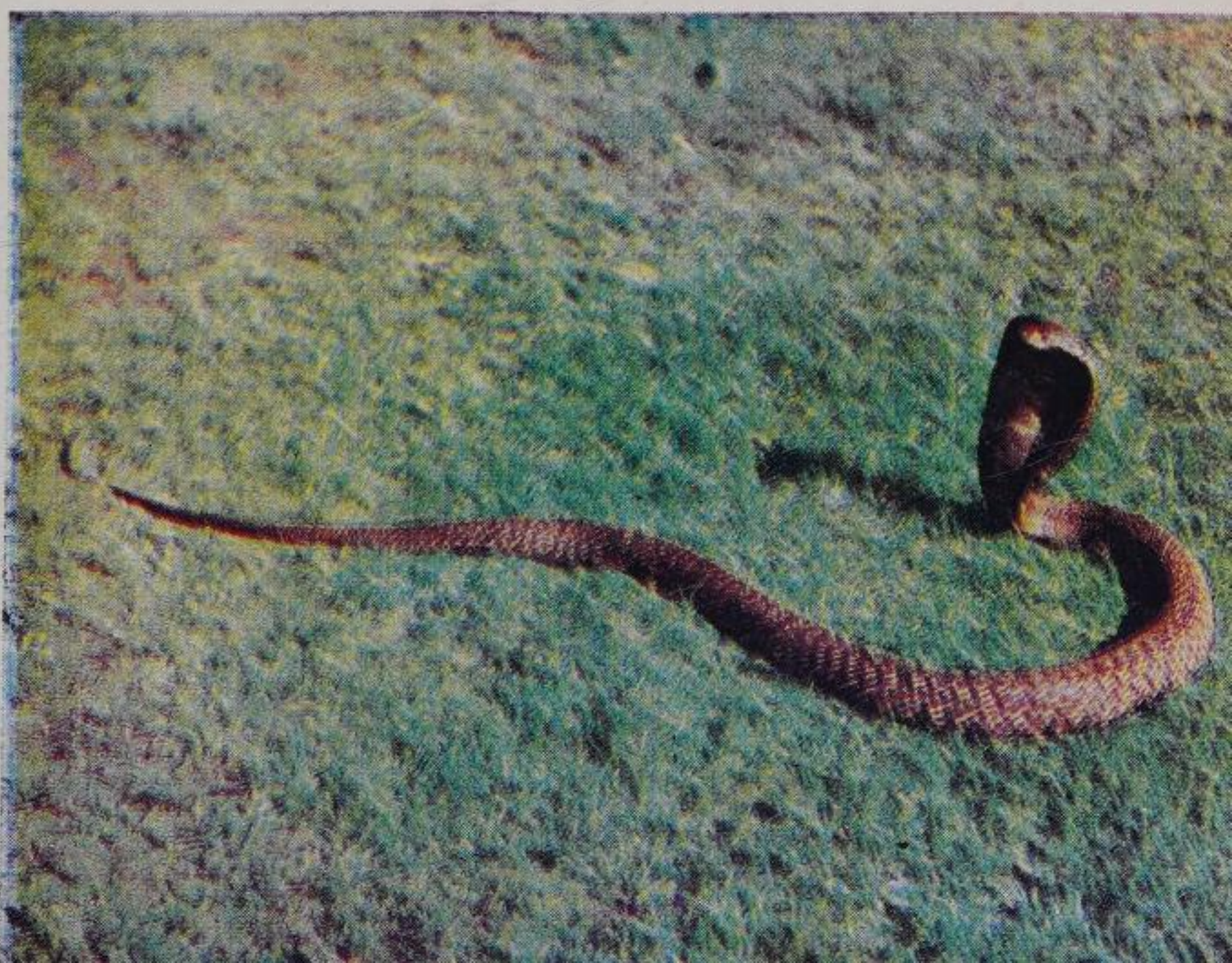


Plate VII(*b*). COBRA (*Naja naja*)
(Dorsal view of hood)

Plate VII(*c*). COBRA (*Naja naja*)
(Ventral view of hood and both alarmed during movement



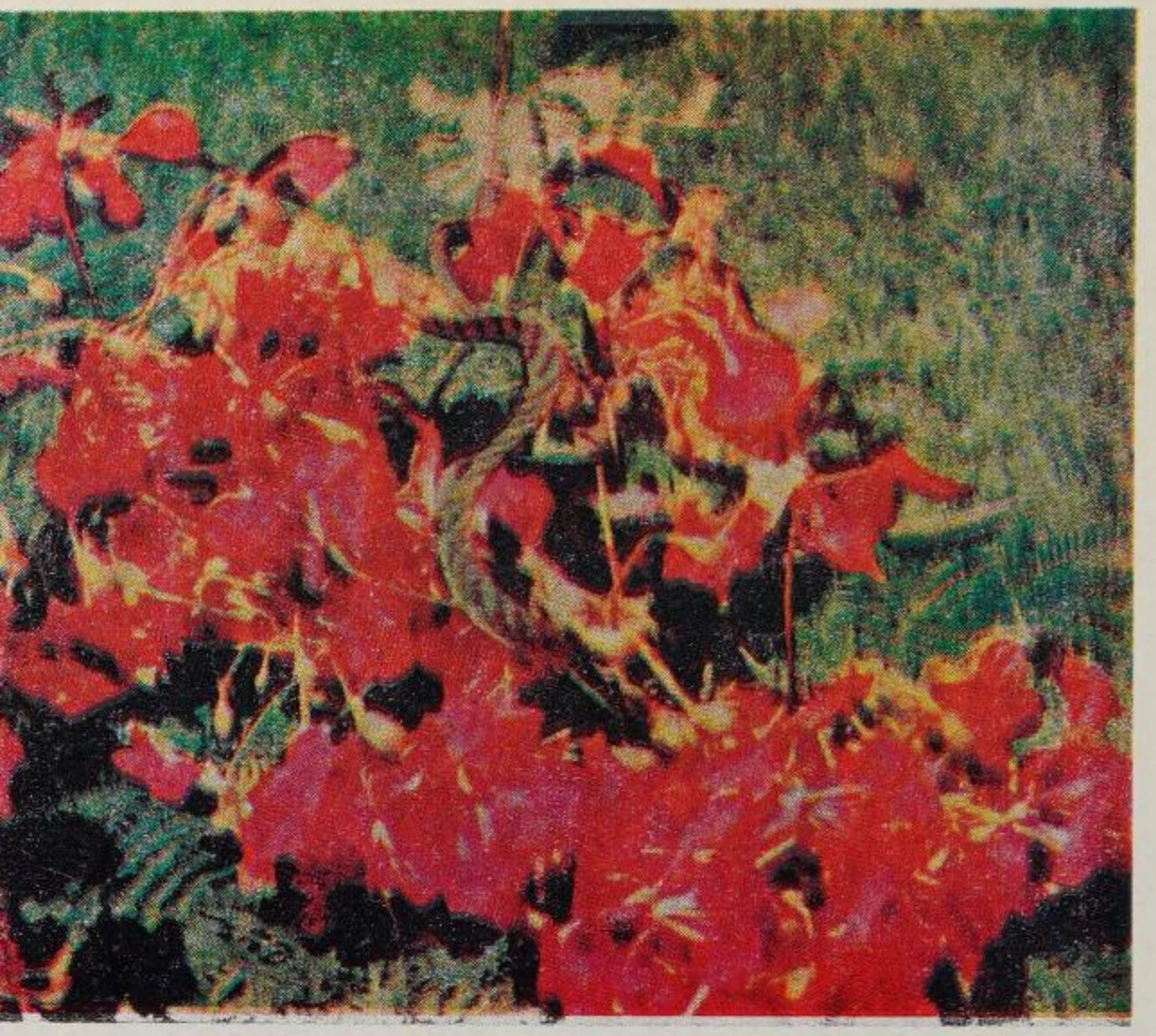


Plate VIII. WHIP SNAKE (*Dryophis nasutus*)
(Hidden among red flowers)

Plate IX. COMMON KRAIT (*Bungarus caeruleus*)

Plate X. BANDED KRAIT (*Bungarus fasciatus*)

Plate XI. RUSSELL'S VIPER (*Vipera russelli*)

Plate XII. GREEN PIT VIPER (*Trimeresurus gramienus*)
(It is about to strike)

Plate XIII. CAT SNAKE (*Boiga triagonata*)

and feeds on fishes and frogs. It is viviparous, producing 6-8 young ones at a time.

Elaphe Helena

TRINKET SNAKE

Malayalam: *Kaatu pambu*
Distribution: Hilly regions, Assam, NEFA, Almora, the Western Ghats.
Length : 1,350 mm. in female and 900 mm. in male.

Dark brown above with deeper brown or black cross bars containing white ocelli. These bars become incomplete posteriorly. There is a dark stripe below the eye and one behind it. Underside is yellowish. Snout small. Prefrontal as long as the internasals. Loreal a little longer. Fifth and sixth supralabial touching the eye. Scales on the body distinctly keeled specially on the posterior part and the tail.

This is a vicious snake. When disturbed it assumes a provocative attitude and strikes. It feeds on lizards, mammals, frogs and snakes. It is an oviparous snake.

Elephe hodsoni (copper head) is found in Kashmir, Laddakh and Sikkim regions. It is locally called "Kulpar". It ranges in length from 1,500 mm in the male to 1,250 mm in the female. The colour is olive green with a number of scales edged with black. The ventral side is yellowish and the outer margins have black spots. It differs from *E. helena* in having the anterior maxillary teeth as largest, snout more than two times as long as eye, fourth and fifth supralabial touching the eye. It has 17 rows of scales which are smooth or faintly keeled.

It is oviparous.

Ptyas Mucosus

Rat Snake

Hindi, Gujarati, Marathi : *Dhaman*
Bengali : *Dharas*
Kannada: *Kiyai hawu*
Malayalam: *Chera*
Tamil : *Surepambu*

Distribution : All over India in plains and also at some altitudes.

Length : 2,250 mm. in males and 1,800 mm in females.

Eyes large and with a round pupil. Iris golden. Head distinct from neck. Loreal region concave with two or three shields, a presubocular, nostrils large, between two nasals. Two post-oculars and fourth and fifth supralabials touching the eye. Supraocular forms a ridge on eye.

Scales on the body 16 to 17 rows, with some rows slightly keeled.

This widely distributed snake (*Plate. IV col.*) is dirty yellow in colour, the tips of scales being black. It has anterior and lateroventral scales having very prominent black borders and cross bars specially on the posterior part including tail. Subcaudals paired and edged with black. Young are olivaceous yellow and the markings are very distinct.

It is an agile snake and can climb a tree easily. It lives mainly in the plains feeding on rodents, frogs, toads, lizards and even snakes. In fact, some grain godowns that had a rat snake were found to be comparatively free from rats. When cornered, it inflates the lower part of the head and can bite viciously. It throws coils of its body on the victim. The tail is long and prehensile. It has been seen to use the tail to tie a knot and exert a pull on the victim *(Plate. 23)*. This snake emits a foul odour on touch and also secretes a black liquid from the anal glands. It is commonly believed that this snake ties such knot on the legs of cattle and sucks the udders. This may not perhaps be true. I have further observed that this

snake when squeezed gives out a guttural noise like that of a kite. In spite of it's ferrocious look, it can be domesticated and handled without being bitten. There is no truth in the belief that it mates with a cobra.

It is oviparous. The eggs are blunt at both ends (*Plate 29*). The young emerge during the rainy season.

Lastly, there are reports to show that this snake and it eggs are eaten in some rural areas. It is a non-poisonous snake.

Coluber Ventromaculatus

RACERS

Marathi : *Nagin*
Distribution : Hilly regions of U.P. and Maharashtra.
Length : 1,090 mm in males, 1,00 mm in females.

Grey dorsally, with a dorsal series of black cross bars or spots restricted to scale borders. There are a series of finer spots at the lateral sides, alternating with cross bars. Ventrally yellowish. Neck with a black stripe and a black bar below the eye. Pupil round.

Head distinct from neck. Nine supralabials. Ninth, fifth and sixth supralabials touch the eye. Sixth supralabial highest and in contact with lower anterior temporal. Two post-ocular, loreal squarish, subcaudals paired. Maxillary teeth 14 to 15. Ventrals with a small keel.

A vicious snake when disturbed, erects the head and flattens the area behind the neck. This quality it shares with another snake, the Banded racer *Coluber fasciolatus*, which is found in the Western part of India, Gujarat, Central India, Nepal and Western Bengal. It feeds on lizards, frogs and birds. It is oviparous.

Coluber Diadema

DIADEMA SNAKE

Hindi : *Rajatbansi*
Distribution : Bombay (Bandra 1963), U.P., Delhi. Also at higher altitudes.

Length : 1,200 mm in males and 1,500 mm in females. Even greater lengths are known to have been recorded.

Specimen collected from Bandra near Bombay was chrome yellow above and pale below. The dorsal surface was full of black marks as if blue-black ink had been indiscriminately thrown all over the body (*Plate. V col.*). These spots are at places rhomboid or often irregular and they extend to the head region also, which looks partly black. The ventral surface was light pink with a few lateral dark mottlings.

Maxillary teeth 16-18. Head distinct from neck. Two loreals, and a series of soboculars seperating the labials from the eye, 3 to 4 postoculars, and 10-13 supralabials. Dorsal scales more or less keeled and in 29 or 31 rows.

Another race of this snake has a variation in colouration containing round or rhomboidal dark spots and a regular pattern of markings with an inverted U-shaped mark on the parietal shield.

The markings in both variations become less distinct in older snakes. This snake has also been observed to go up a tree where the typical colouration gives it a good camouflage for hiding. It can be mistaken for a Russell's viper. But the latter has a triangular head and its shields are not defined.

This snake feeds on frogs, lizards and sometimes on rats. It is oviparous and is commonly seen during the rainy months.

Liopeltis Calamaria

Distribution : Western Ghats, Mysore plateau, U.P., Tarai regions and Eastern part of M.P. and Orissa. Mostly in hilly regions.

Length : 335 mm in males, and 390 mm in females.

It is a small brown snake having a greenish tinge, the scale borders indicate a black line that runs longitudinally along the vertebral column. Between these lines the colouration is deep brown. The lower side is yellowish and the head bears a series of black spots resembling a stripe extending upto the temporals.

The head is distinct from the neck. Maxillary teeth 24-26. The undivided nasal is united with the loreal. Supralabials 7th, 3rd and 4th touching the eye. The dorsal scales are in 15 rows.

This snake has been recorded in Matheran near Bombay. It is not a very common snake of the plains. It feeds on lizards and small birds and is common only in the hilly regions. It is oviparous.

Coronella Brachyura

Distribution : North India, Poona area and Vidarbha region of Maharashtra.

Length : 515 mm in males and 450 mm in females.

This is not a very common snake. It is olive brown above with variegated colour spots or is light brown particularly on the anterior part of the body. Ventrally white.

The nostrils are large. There are two postoculars and supralabials; fourth and fifth of which touches the eye. Dorsal scales are in nineteen rows of twenty-three scales and the ventrals are large and rounded.

This is a small snake, about 100 mm in diameter and has been observed in the day time. It probably feeds on tiny frogs and young lizards and is commonly seen during the rainy season. It is oviparous.

Oligodon Venustus

WOLF SNAKE

Hindi : *Kawdi samp*
Gujarati : *Sankh-bangani*
Malayalam : *Grachurute*
Marathi : *Gargar*

Distribution: Snake belonging to this genus are common all over India. This species is to be found in the Western Ghats up to Travancore.

Length : 450 mm in males and smaller in females.

The snake is grey with a brown tinge and has paired black spots on the dorsal side. These spots have a white border and look like the cross-bars of a krait. There are yellowish spots on the lateral side and the ventrals are white. The head has crenate markings and the caudals are paired.

Maxillary teeth 6-16, the posterior very strongly enlarged. Palatine teeth well developed or vestigial. Eyes moderate with a round pupil. Hypophyses absent on posterior dorsal vertebrae. Nostril on an elongated nasal. Two post-oculars. No loreal, 6 supralabials, 3rd and 4th touching the eye. Posterior nasal elongate, sometimes meeting the preoculars.

They feed on small rodents, lizards and birds and even insects. This snake is found in gardens and round about houses and it preferably comes out in the evenings. In the semi-darkness of the night, it is often mistaken for a krait.

It is a non-poisonous harmless snake and is oviparous.

Oligodon arnensis (Plate 34 a, b) is also extensively found in this region. It is brown with distinct cross markings and narrow dark brown crossbars ranging from 31-41, depending upon the age of the snake. These markings are indistinct on the tall and run as double limbed dark stripes behind the eyes to the neck region. This snake looks like a krait in colouration.

Ahaetulla Grandocullis

BRONZE-BACK SNAKE

Distribution : The Western Ghats up to Travancore.
Length : 1,280 mm in females and less in males.

These are greenish brown snakes with black blotches on the dorsal side. The tail has three black lines, one below and two laterally. No longitudinal stripes on the body or head except white rings round the eyes.

Maxillary teeth are 31-33, nine supralabials, 4th touching the eye and 5th and 6th below the eye. Vertebral scales are slightly enlarged. Head is distinct from the neck. Eye has a round pupil. Loreal region is concave. Hypophyses are absent on the posterior dorsal vertebrae and are represented by a low keel.

These snakes are found on trees and shrubs, feeding on birds eggs. On land they go in for frogs, toads and even lizards. They are very quick in their movements across tree branches. They are timid and can be easily handled.

Ahaetulla tristis is another bronze-back snake very commonly met with in India, particularly at higher altitudes. These are bronze brown with buff flank stripes edged with black spots. Upper lip is yellow. Maxillary teeth are only 17-22, 5th and 6th supralabial are touching the eye.

They are oviparous and the gestation period is supposed to be very short.

Chrysopelea Ornata

GOLDEN TREE SNAKE (FLYING SNAKE)

Bengali : *Kala nagini.*
Distribution : Central India, Bihar, Orissa extending to Bengal, Western Ghats.
Length : 1,100 mm in females and 1,040 mm in males.

It is pale green dorsally with blackish cross-bars formed by black edged scales at regular intervals. Some specimens have orange spots on the vertebrals. Ventrals are greenish. Laterals are slightly keeled and with a black spot. The head is black with a thin yellow or pale green cross bar and a few spots. Subcaudals are with a black median streak or spots.

Maxillary teeth are 20-22, 3rd and 4th are partly grooved. Loreals are elongate, with two postoculars, nine supralabials, 4th just touching and 5th and 6th below the eye. Snout is depressed. Internasals are shorter than prefrontals, and frontal is bell shaped. Scales on the body are smooth, and the caudals are paired.

This snake feeds on lizards, small rodents, birds, snakes and even insects. It may be seen near houses. The peculiarity about this snake is its capacity to move very fast. It can spring and move as if it is flying. It is therefore called a "flying snake". It can suspend itself from tree branches and attack a prey on the tree, kill it by coiling and feed itself while still suspending from branches. It is oviparous.

Lycodon Aulicus

COMMON WOLF SNAKES

Hindi : *Kawadivala*
Bengali : *Chitti*
Gujarati : *Suwarpankhu*
Malayalam : *Shuguwarian or Vellivaryan Pambu*
Tamil : *Kuwarpambo*
Distribution : All over India.
Length : 760 mm in males, 760 mm in females.

Brown or purple dorsally, and with grey spots edged white, which form a reticulate pattern of cross-bars expanding laterally (*Plate 35*), Upper lip white or with brown spots, ventrals yellowish.

Maxillary bone arched with 3 to 6 anterior teeth increasing in size and looking like fangs. Loreal in contact with internasals. Nine supralabials, 3rd, 4th and 5th touching the eye; two postoculars. Subcaudals are paired. Hypophyses absent in the posterior part of the vertebral column.

These are garden snakes, more or less nocturnal in habits. They climb trees readily and on land show active movements. They are very vicious and bite ferociously. Their main food consists of lizards, Gekos and skinks (*Plate 35-b*).They also go in for frogs and small rodents as well as eggs of birds.

They readily enter human habitations and are oviparous.

Like Oligodon, one may mistake this snake for a krait, due to the shape of the faint cross bars. The shape and size of dorsal scales and paired caudals distinguish this snake from the other.

Dryocalamus Nympha

BRIDAL SNAKE

Tamil : *Katlawarian.*
Distribution : South India, Western Ghats, Orissa.
Length : 460 mm in males, females are smaller.

Deep brown above with yellowish white broad cross bars on the dorsal side, particularly in the anterior region, yellowish

spots posteriorly. Head yellowish posteriorly and lips white ventrally (yellowish white). Head is coloured deep brown up to the eyes.

Loreal in contact with the eye or separated by a small preocular. Two post-oculars, six to seven supralabials, 3rd and 4th touching the eye. Hypophyses absent on the post dorsal vertebrae.

This is a snake of the plains and is found at low altitudes only. It feeds on lizards and frogs and is oviparous.

Natrix Piscator

CHECKERED KEEL-BACK

Hindi: *Pani samp*
Bengali : *Joldhorna*
Gujarati : *Neer mandli*
Malayalam: *Neerkoli*
Marathi : *Pandivad*
Tamil: *Tanir pambu*
Distribution : All over India.
Length : 990 mm males, 1,200 mm females.

Olivaceous snakes with dorsal black spots arranged in a pattern, of one series on vertebrae, two at sides and two laterally. These five series give the impression of a chessboard arrangement (*Plate VI. col.*). The pattern is more prominent posteriorly, and often these spots touch one another. A black stripe at the nape and two black lines from behind the eyes run along the margin of sixth and eighth supralabials to the end of the upper jaw. Eyes round and seem surrounded by a white circle. Ventral side is white with black borders more prominent in the posterior region.

Maxillary teeth 22-28, enlarged posteriorly. One preocular, and nine supralabials, 4th and 5th touching the eye. Scales are in 19 rows, keeled, ventrals rounded and subcaudals paired. Hypophyses developed throughout the vertebral column.

This is a very common snake of the plains which goes near water to eat frogs and fishes. Probably the food consists mainly of fishes which it eats assiduously. It is often encountered

in paddy fields during rains or one could meet it near shallow pond banks. In the laboratory I have observed it floating in water with just the tip of the nose sticking out. The rest of the body lies coiled at the base. With the least disturbance it sinks down and one could see air bubbles rise up as it goes down. Here, I have found it lying in water for the major part of the day remaining completely submerged for more than fifteen minutes. It is said that in hot weather it may estivate, while in North India it hibernates during cold months.

A number of people are often bitten by this snake. It bites very viciously, often flinging at the victim. The snake is nonpoisonous.

It is oviparous and has been seen to lay eggs in March-April in Bombay. The young ones appear in May-June of the same year.

Natrix Stolata

BUFF STRIPED KEEL-BACK

Bengali : *Halhalliah, Hur-hur-ra*
Hindi : *Seeta-ki-lat*
Malayalam : *Therlian or Theyyan pambu*
Marathi : *Naneti*
Tamil : *Wanapambu*
Telugu : *Vanacogli*
Distribution : All over India.
Length : 720 mm in males and 620 mm in females, circumference about 30 mm.

Olive green snake with reticulated black spotted irregular crossbars dorsally, and two buff coloured longitudinal stripes running all along the body. These stripes are prominent posteriorly. Head with black bordered shields. Mouth with a cream coloured region extending upto eyes.

Maxillary teeth 21-24, the last two enlarged. One pre-ocular, supralabials eight, third, fourth and fifth touching the eye. Dorsal scales in 19 rows, strongly keeled. Loreal streak is short and black. Last supralabial has a black border. Scales on body 19.

This is a very common snake in India and is seen in large

numbers during the monsoon months. It is very docile and can be handled with ease. One sees it both during the day and the night. It hibernates during winter months. Egg laying takes place in heaps sometime in April-May and young ones are seen during the rainy season.

It feeds chiefly on frogs and insects and is an absolutely harmless snake.

Macropisthodon Plumbicolor

GREEN KEEL-BACK

Malayalam : *Pachanagam*
Marathi : *Gavtya*
Tamil : *Pacha-Naga*

Distribution : All over India at high altitudes.
Length : 485 mm in males and 690 mm in females.

It is grass green dorsally with lamp-black chevron-shaped mark on the nape and black short cross-stripes across the body. The posterior part of the eye has a streak in black, looking like a eyeblack in eyes. Ventral surface whitish. Yellow thin lines run laterally. The head has another chevron shaped mark. The head is orange in colour between this mark and the one on the nape.

Maxillary teeth are 11 or 12. Loreal touching second supralingual and united with lower pre-ocular. Post-ocular 3, pre-oculars 2, supralabials 7 of which 3rd and 4th touch the eye. Scales on the body are strongly keeled except the outer rows.

This is a common snake of the hills. It is found in green vegetation in the open or near houses. It is sometimes mistaken for a pit viper. But the well-defined scales on the body and the black stripes clearly distinguish it from a viper. It feeds mainly on amphibians and may go in for small birds. Normally a very gentle snake, but when badly provoked expands the neck and even the body, and like a cobra, raises its head with the neck and strikes.

It is an oviparous non-poisonous snake.

Boiga Trigonata

CAT SNAKE

Malayalam : *Churta*
Marathi : *Manjar Sarp*
Malayalam : *Poochakanna pambu*
Tamil : *Chingihawu*
Distribution : All over India.
Length : 825 mm in males and 990 mm in females.

Greyish brown snake with dark inverted V-shaped yellow-black bordered marks along the vetebral ridge. Belly whitish with black spots at the sides. Head with a large lung-shaped brown patch, edged with black, extending from frontal to parietals and their black arms extending upto neck. Yellowish brown stripl from eye to the end of the jaw (*Plate 28*).

Maxillary teeth 8 to 10, last few teeth enlarged and some grooved. Head distinct from neck, eyes large with a vertical pupil and yellow iris. Pre-ocular 1, loreal 2, supralabials 9, 3rd, 4th and 5th touch the eye and infralabials 7 of which 3rd and 4th touch the posterior linguals. Nostrils between two nasals. Dorsal scales with apical pits and in 21 : 21 : 15 rows. It is a very vicious snake which assumes a provocative attitude with the least disturbance. It raises the head and keeping it in between coils of neck opens the mouth widely to strike tenaciously. It bites and also strangulates the victim with the pressure of the coils (*Plate 28*).

It feeds on frogs, and sometimes or rodents. An oviparous vicious snake that resembles a Cobra; while raising its head, the two black streaks at the sides of the nape give this characteristic impression. It is essentially a tree snake (*Plate XIII col.*)

Dryophis Nasutus

COMMON GREEN WHIP SNAKE

Bengali : *Lawudaga*
Gujarati : *Kankoti pankhu*
Malayalam : *Pachola pambu*

Marathi : *Sarptoli*
Tamil: *Kankoti pambu*
Distribution : All over India.
Length : 1,325 mm in males and 1,940 mm in females.

Parrot green all over with dorsal side full of faint black and white oblique lines which are well-defined in the anterior region. There may be a yellow line followed by a faint blue line running along the sides. Ventrals pale green with a white or yellow streak laterally giving the impression of two lines at the sides. Mouth with a yellow tongue and a sky blue throat (*Plate. VIII col.*).

Maxillary teeth 12-15. Last two enlarged and grooved. Body very elongate. Hypophyses absent on the dorsal posterior vertebrae.

The head is elongate forming a pointed pale green tip in front of and above the mouth. This has a dorsal groove medially and is an elongation of the rostral shield. No loreals, internasal and prefrontals are in contact with labials. Pre-ocular 1, post-ocular 2, supralabials 8; 5th touching the eye. The 3rd or 4th supralabial divided to form one or two presuboculars. Well-defined eye with a horizontal pupil and a bright golden iris. These, coupled with the forward position of the location of the eye, give this snake a very good vision. There is a well-defined ridge on the eye formed of the supraocular shield.

This gentle snake inhabits high grasses, bushes or trees. It has been seen on coconut, banyan or ficus tree tops. It remains suspended by its long thin tail, the head being held free from the coils. It has the habit of swaying slowly the head and coils of body and trying to take an aim at shining objects. Many people think that this is hypnotism. However, it does strike viciously and even puts a few coils round the victim. The food mainly consists of birds, lizards and some insects.

The snake is oviparous. It is a non-poisonous snake, but its bite has produced pain and swelling. The bite probably may be lethal to birds and smaller forms of life. While in captivity, the snake goes on striking against the glass in the cage and damaging the projection of its rostral shield. One therefore, finds this snake in a cage with a bent in rostral shield

projection. This snake finds it easy for moving atop a tree from branch to branch than on the ground. The colouration is in harmony with the natural surroundings, and it is difficult to spot this snake even though it may be very near one's face up a tree. *Plate No. VIII* of the coloured plate shows the colouration and camouflage.

Psammophis Leithi

SAND SNAKE

Distribution : Regions North of Gujarat, the Punjab, Kashmir, Rajasthan, Tarai of U.P.

Length : 765 mm in females, males probably smaller.

This light brown snake has four deep brown longitudinal stripes. These start from above the eyes reach upto loreals and extend by the side of vertebrals upto the tail. They have black spots at their outer edges. Two more stripes are present running from behind the eye to the end of the head. These also have black spots. Both these stripes extend to about one scale in diameter. There is also a median faint brown stripe from frontal to rostral shield on the head. The ventral surface is pale yellow.

Maxillary teeth are 11 to 12. Supralabials 8, 4th and 5th touching the eye. Five infralabials in contact with the anterior genials. Two post-ocular, one pre-ocular and one loreal. The pre-ocular touching the 4th suprabial.

This timid snake often remains in hiding. The eyes are small with round pupils. It feeds on frogs and lizards and is oviparous. It may enter house gardens in the rural areas but with the least disturbance it sneaks away.

Cereberus Rhynchops

DOG-FACED WATER SNAKE

Hindi : *Pani-ka-samp*
Marathi : *Pansarp*
Bengali : *Nonaborah*

Distribution : Coast and tidal rivers of India.

Length : 770 mm in males, 1,100 mm in females.

Bluish grey with well defined darker cross bars and spots. These are indistinct posteriorly and prominent anteriorly. Head with a dark post-ocular streak slightly passing through the eye. Lower surface pale yellow with black spots at the edges.

Head pear-shaped with a narrow snout. Nostrils directed anteriorly upwards and laterally. Eyes small with speckled iris and an elliptical pupil. Body stout and rough, keeled, slightly on costal side. Tail short, compressed at base and tapering to an obtuse point.

Nostril connected by a suture to the 1st labial. Pre-ocular 1, post-ocular 2 and suboculars 2, supralabials 9, 5th and 6th below the eye, but not touching the eye. Four infralabials in contact with marginal scales. Scales on body striated or partly keeled.

These snakes are primarily met with in tidal rivers, creeks and estuaries close to the sea. They seem to anchor with their tail to vegetation and feed on fishes and eels. When the tide is out, one could see them stranded. They are not good crawlers on land. Normally timid by nature, they give out a disagreeable odour from cloacal discharges and bite viciously when cornered. It is an oviparous snake.

FAMILY : DASYPELTIDAE

Elaschistodon Westermanni

Indian Egg-eater

Distribution : Bengal, Bihar.
Length : 800 mm in female, males not recorded.

These are olive coloured snakes with black spots. Head with black area from rostral to neck running above eye separating it from the yellow margins. Stripes of black run from eye angles to the neck region. Eyes with a vertical pupil. Body covered by black spots interspersed with yellow dots. Vertebral column with yellow spot in between black irregular semi-cross streaks. Lips are yellow.

Maxilla rough with a few tiny teeth followed by two small grooved fangs at the posterior extremity.

There is no clear differentiation between head and neck. Nasal scale well enlarged. Pre-ocular 1, loreal below pre-ocular and touching the eye, post-oculars 2, supralabials 7, 3rd and 4th touching the eye. Scales on body in sixteen rows, the vertebral are slightly enlarged and hexagonal. It is for this reason that this snake may be mistaken for a krait, but the vertebral scales are not defined and the caudal scales here are paired.

Tail short and hypophyses absent in the posterior part of the vertebral column. Oviparous, timid snakes supposed to feed on eggs, by swallowing them. The colouration makes it look fearful, but the snake is not ferocious or poisonous.

POISONOUS SNAKES

FAMILY :, ELAPIDAE

Bungarus Caeruleus

The Common Krait

Hindi : *Karayat*
Bengali : *chitti;*
Kannada : *Godinaser*
Malayalam : *Mothira valayan*
Marathi : *Maniyar*
Tamil : *Yannabarian*

Distribution : All over India.

Length : 1,500 mm Males are larger.

This is a snake of the plains, though some have been found at an altitude of 4,500 feet. Further, this snake is often confused with *Lycodon aulicus* and *Oligodon* species. Both these are non-poisonous snakes. There are distinct differences between these two snakes, whereas a Krait is distinctly steel blue in colour, the other two snakes are brownish. There is distinctly an enlarged chain of hexagonal scales on the dorsal side in a Krait, and the ventral scales beyond the anal to the tip of the tail are not divided. There is no enlarged vertebral hexagonal scale as well as complete ventrals beyond the vent in the other two snakes.

Head not distinct from neck. Head shields are normal. No loreal. Post-oculars 2, pre-ocular 1, supralabials 7, 3rd and 4th touching the eye. Eyes moderate or small with round pupils. Scales smooth, polished and in 15-17 rows. Ventrals are 194-234. Caudals 42-52. The dorsal scales largely enlarged. In fact, this forms a hexagonal pattern all along the vertebral column (*Fig 12-1*). The ventral scales beyond the anal region in a single row (*Fig. 11-5*). The colour is smooth, steel blue

and often shining. There are rows of paired white stripes across the body. This colour and stripes vary in distribution. The stripes are not very distinct in the anterior region. Similarly, some specimens in Maharashtra State showed mere white spots on the dorsal side without any cross bars. In some specimens, even these spots were very faint. The younger specimens do not have a distinct steel blue colour and the stripes are more or less very close. At a later stage, they may separate (*Plate. IX col).*

The eggs of this snake are laid between April and May, while they hatch in about 45 to 60 days. The newly-emerged young ones are hardly 150 to 200 mm in length and grow at the rate of about 300 mm per year. These snakes are nocturnal in their habit and live in cracks in walls or in heaps of stones or bricks. There is a suspicion that they make a vocal noise specially in the morning.

This snake is poisonous. The venom is neurotoxic. There is not much pain at the site of the bite but in about an hour, the victim feels sleepy and unless an antivenom is given in time, and if a lethal dose of venom has been injected, the patient may not survive. The snake not only eats mice but also other snakes too. In our snake farm, this snake had eaten its fellow Krait.

Bungarus Fasciatus

THE BANDED KRAIT

Bengali : *Shankhini*
Hindi : *Ahiraj, Rajsanp*
Marathi : *Agimanyar*
Distribution : Assam, NEFA, (Missimari and Chardwar), M.P., Bihar, Orissa, Tarai region of Uttar Pradesh. Maharashtra, Karnataka, Kerala, Bengal, Tripura
Length : 1,700 mm Males are longer.

Scales are in rows of 15, dorsally. The tail ends bluntly and is swollen at the tip. Ventrals 200-234. Caudals 23-39.

This is a beautiful snake having jet black 500 mm wide cross stripe alternating with a deep yellow stripe of the same

size on the body. There is a black mark on the neck which is spread up to the eyes. There are median black spots sometimes on the head. The dorsal portion of the body has a marked continuous projection like a ridge along with enlarged hexagonal central row of scales. The ventral row of scales beyond the vent is continuous (*Plate. X col.*).

In Madhya Pradesh, this snake is often seen after a few showers. It feeds on other snakes and the villagers do not drive it from their farms because it helps to keep snakes and rats away. It is oviparous. The venom is neurotoxic.

Bungarus Niger

THE BLACK KRAIT

Hindi : *Kala Karayat*
Distribution : North-Eastern Provinces, Assam, Darjeeling.
Length : 1,200 mm Males are longer.

This snake is shining steel blue or black and is devoid of any white stripes. The ventral side is white with black spots. There are 15 rows of scales all over the body. A smaller species which is slightly less black has been reported from Rangpur, Jalpaiguri, Darjeeling and Dibrugarh. It is mentioned as *Bungarus lividus.*

Callophis Melanurus

SLENDER CORAL SNAKE

Gujarati : *Ritugana*
Malayalam : *Ezhuthoni murkhan*
Marathi : *Raat*
Distribution : Low hilly regions of Maharashtra, Nagpur district, Dharwar district of Mysore, Kerala, Coimbatore and Annamalai in Madras.
Length : 335 mm. Males are longer.

This snake is light brown above, and the centre of each scale is speckled with brown, forming a series of longitudinal lines all along the body. head and neck black above, with

yellow spots. Tail with 2 black rings, one at base and the other at tip. The ventral surface is pink in life *(Plate 31a & b).*

Two or three minute teeth are present behind the poison fangs. One pre-ocular in contact with nasal, 2 post-ocular, 1+1 temporal, 6 supralabials, 3rd and 4th touching the eye, 5th and 6th in contact with the temporal, 2 pairs of genials, and 13 rows of dorsal scales, ventrals 249-277.

This snake is poisonous. In Maharashtra, it is believed that if this snake bites at night, the victim will die before daybreak. That is why it is called "Raat". The venom is neurotoxic. Fortunately these snakes are not very common. They are oviparous.

Callophis Nigrescens

CORAL SNAKE

Malayalam : *Ettidi murkhan.*
Distribution : Panchgani, Mahabaleshwar (Maharashtra), the Nilgiris and Shevaroy Hills, Annamalai and Kerala.
Length : 1,140 mm Males are longer.

Beddomme thinks that this snake grows up to 1,100 mm or more and is thinner than the human index finger. Wall thinks that it feeds on other snakes and is inhabitant of altitudes over 3,000 feet. This snake has 30 rows of dorsal scales and its other characters are like those of *Callophis melanurus* except that it may be pale pinkish dorsally with 5 black stripes on the body, a vertebral, 2 lateral and 3 on the tail; the top of head black with light regular markings, a broad black bar on the nape, red ventrally, and the upper lip with black vertical marks.

In Nilgiris it is dark purplish brown with 5 black stripes edged with white; the white lines being continuous.

Blackish and greenish blue dorsally with 3-5 black stripes *not* edged with white; reddish ventrally. This was collected in Panchgani and at Mahabaleshwar and Mangalvedha personally by the author. They are oviparous.

Naja Naja

COBRA

Bihari, Oriya, Hindi, Gujarati, Marathi : *Nag*
Assamese, Bengali : *Gokhura*
Kannada : *Sarpammuikan, Nagar Havu*
Tamil : *Nala Pambo*
Malabar : *Moorkhan pambu or Nagam*

Distribution : All over India.
Length : Upto 1,800 mm. Males are longer.

In English, Cobra is a particular snake ; but in Portuguese the word 'Cobra' means any snake. It will therefore be desirable to call this snake "Nag" rather than Cobra.

The head of this snake is not very distinct from the neck. The neck region is dilatable, the ribs being elongate. The expansion of this region forms the hood which bears on the upper side a binocellate mark which some people call a mark of spectacle or the figure of ten. There is a white band in the region, where the hood touches the body region. In the Assam region. this mark is monocellate forming only a ring with a black mark in the centre. In the Rajasthan and Punjab areas, the binocellate mark is not complete in the lower region. It thus forms two lines only. There may be no mark at all. *Plate No. 36* shows the skins of different types of hood marks found in Indian Cobra snakes. The under-side of the hood bears two black round spots running to four scales surrounded by white lateral borders. There are three dark bands on the underside of the hood. Even if the mark on the upper side is absent, the underside invariably bears the three transverse bands which are quite a distinctive feature of this snake (*Fig. 35*). Similarly, this snake is brown or dark in colour. The brown are called "Gehuwa" and the dark ones "Domi" in the Hindi speaking areas. Sometimes one comes across a golden yellow colour in this snake, particularly before the monsoon. This colour changes to brown when the snake is exposed to sunlight. The golden colour is due to winter hibernation when the snake remains in seclusion away from light. We often see such colouration also in frogs which are seen absolutely yellow at

the first onset of the monsoon, but turn olive and deep brown after a few hours of exposure to light. In the lower Rajasthan, an albino variety of the cobra is occasionally met with. There is a faint impression of marking on the hood and faint dark bands on the underside of the hood of this Cobra. Local people call it "Basuki nag". There is nothing special about it, except the albinism.

In the Bassein region of Bombay, the Nag bears some V-shaped cross-bars on the body. The Assam monocellate Cobra also bears such crossbars (*Plate 36*). Collections from a number of regions in India show such faint markings on this snake.

Apart from the above distinctive features, this snake could further be identified by the smooth oblique scales on the body, which are 25-35 on the neck, 21-25 in the mid body and 15-17 at vent. The caudal scales are paired. The ventral scales range from 176 to 200. There are variations in these scales and the snake is further identified accordingly.

The male cobra snake is heavier and longer than the female. The following figures which are an average of 27 snakes indicate some of these measurements.

(a) Male, length 1.47 m. 560 gms.
Female, length 1.47 m. 355 gms.
(b) Mx. Male 1.60 m. 1247 gms.
(c) Ratio of length to width of hood.
Male - 1 : 0 : 0.63
Female 1 : 0 : 0.59
(d) Ratio of body length to tail
Male - 1.0 : 0.18
Female - 1.0 : 0.17
(e) Extention of Binocoellate Mark on the head - 10 rows of scales.
(f) Total width of Binocoellate mark - 15 rows of scales.
(g) Width of each arm of the Binocoellate mark - 2 rows of scales.
(h) Dark stripes on the ventral side of head extend upto 10 - 17 scales.

Maxillary bone extends beyond palatine. Poison fangs are followed by 1-3 small teeth. The neck is dilatable, the anterior ribs being elongate. Nostrils are between an anterior and

posterior nasal scale. Loreal is abent. Scales on body are placed obliquely. Eyes are round, equal in diameter to its distance from the mouth. Nostrils large, vertically elliptic, frontal larger than broad with a truncate anterior margin. Internasals, as long as or a little shorter than prefrontal, preocular usually in contact with the internasal.

Some head scales form a typical identifying mark for this snake. The frontal shield is truncated (*Fig. 10,IV*). There are three postocular scales. The third supralabial is big and touches the nasal and the eye. There is a small triangular scale edged in between the fourth and fifth infralabials and there are three black stripes on the underside of the hood extending from 10 to 17 ventrals. There are two black spots extending from four to six scale, size between 15 to 30 ventral scales on the underside of the hood.

The male cobra snakes have a longer tail, and the hood as well as the head are wider. Similarly the males are heavier than females and yield more venom than the females.

This snake is common all over India. It is normally seen in the open in the evening or early morning. In old thatched-roof houses, it has been seen under the roof where it may have gone in search of rats. In very old buildings, it has been noticed in crevices, presumably in cool dark places where rats are also available. It may be noted here that the presence of this snake in and near houses is an indication that it has come for its food; the rat, frogs or birds. If these are kept away, this snake may not come to houses. A cobra strikes in self defence or when disturbed during its search for food or during the mating season.

This snake is worshipped. During *Nagpanchami* day, it is taken from house to house, offered milk and money. Whenever a person is bitten by a snake, it is often taken for granted that it must be a cobra. The local charmers then gather in a temple and the victim supposed to be possessed by the cobra is made to lie down. The patient froths from the mouth and is often given *neem* leaves (*Melia azardirecta)* which are bitter or chillies (capsicum) which are hot, to chew and the face is sprinkled with cold water. However, it is significant to note that in all temples of the villages a spell is cast only for a cobra bite. We have not come across a charm or mantra to cure a

Krait or a Russell's viper bite. Many old buildings are believed to be inhabited by a cobra which is supposed to be "a guardian of wealth". Under pipal trees (*Ficus religiosa)* are kept images resembling a cobra's hood and there is a belief that circumambulation of such trees confers fertility *(Plate. 6).*

There is no truth in the belief that a cobra has a jewel on its head *(Plate 24).* There is hardly any evidence to show that a cobra takes revenge even after a lapse of some time or that it is lured by soft music *(Plate. 2)* or that an old cobra has white hairs or moustaches *(Plate. 19).* These and allied points have already been discussed in the first two chapters. This snake sheds skin more frequently in summer months. The younger snakes shed it quicker. It normally raises the hood about 2 1/2 feet from the ground and the striking range comes to a radius of about the same length. If one keeps still and beyond this range, it is quite likely that the snake will retreat. But if one moves or runs, it is also likely that the snake will give chase for some distance. Due to fright the speed of the runner is reduced and accidents do happen. The speed of a cobra is far less than that of a man *(Plate. VII a, b & c col.)*

These snakes mate during the rainy season. The mating is done in a lying down position. One often observes two cobras coiled up above ground and swaying. It has been seen that these are both males and the phenomenon is probably a fight between the two males. Egg-lying takes place about nine to ten months after mating. This happens in the month of April. I have seen 56 eggs laid in three days. The female sits on the eggs which are mixed with the soil and dry vegetation. The female does not leave the eggs alone. The eggs start hatching after 58 days. The young ones have a properly formed hood, and strike in the same fashion as the adult. There is venom in the glands of the young snakes and this could be lethal. The shedding of the skin is done first on the 2nd day, then on the 7th, and later on the 21st and the 30th days. The shedding is less frequent after this. The young snakes probably do not feed for a few days. Later, after about a month, they have been seen to go in for young frogs, young mice and young lizards. On birth the snake is 8" to 10" long, after one year it is 2' 6" and by four years it is about 5 feet. It probably matures after three years.

The poison of this snake is primarily neurotoxic. There is less pain, slight swelling, irritation and death is due to respiratory failure.

If a sufficient amount of venom has been injected by this snake, the only remedy is the antivenin. A few *mantras*, herbs and charms have actually been given trial on laboratory animals, but these could not save the animals.

Naja Hannah

KING COBRA (HAMADRAYAD)

Hindi : *Rajnag or Nagraj*
Gujarati : *Rajnag*
Kannada : *Raj Nagara Havu*
Malayalam : *Karinadan pambu*
Bengali : *Shankh-churh*
Marathi : *Rajsamp*

Distribution : Assam, the Nilgiris, Bengal the Londha region of Karwar and higher altitudes.

Length : 4,500 to 5,400 mm. Males are longer.

This snake is found in fairly dense forests, particularly at a higher altitude. It grows up to 18 feet. In young age, the snake is olive or light black with thick faint yellow chevron-shaped stripes all over the body. In older specimens, the colouration of the stripes becomes faint. On the head are four chevron-shaped bars distinctly seen in the younger snakes. In fact, the older specimens look just faint black with very faint stripes or no stripes at all (*Plate 39*). The hood is less wide, but longer than that of a cobra. The scales on the neck are only 17-19, the ventral scales being 240-254. The difference between this snake and cobra consists of :

(i) Frontal is not truncated in Naja hannah,
(ii) The enlarged supralabial just touches the nasal and eye,
(iii) There is no triangular scale wedged in between fourth and fifth infralabials,
(iv) Pair of occipital scales (*Fig. 10L*) are present beyond parietal, and
(v) Few caudal scales near the anus are unpaired, while the rest are paired.

This snake usually feeds on other snakes which include both poisonous and non-poisonous ones. However, I have observed that a King Cobra, whose fangs had been pulled away, ate a rat-snake by chewing it and probably trying to force the venom into the lacerations. As snakes are found in secluded places and these comprise its main diet, it has to keep any disturbance away from such area. It is for this reason that this snake tries to attack anyone with the least provocation. It raises it head often upto 3 feet in height and stands in a very aggressive position. Mating may take place in the rainy months, but the eggs are laid in April. In fact, the snake makes a nest of bamboo leaves and twigs and lays eggs in the lower compartment. A nest was laid for this snake in the New York Zoo cage and the picture of this taken by Dr.Oliver, Director of the Zoo, is given in *Plate 40*. Here the snake is seen emerging from the egg.

Considering the size of the snake, the amount of venom given out is much more than that by a cobra. It is probably this quantity of venom that may account for its lethal character. However, tests done at the Haffkine Institute have shown that the antivenin that works against cobra venom can be used for neutralising King Cobra venom also. As this snake is rare, the number of deaths due to its bite is also negligible.

FAMILY : HYDROPHIDAE

Hydrophis Caerulescens

SEA-SNAKE

Hindi, Gujarati, Marathi : *Samudra sarp*
Malayalam : *Valyan Kondali*
Distribution : All along the coasts of Peninsular India.
Length : 820 mm in males, 740 mm in females.

The snakes are sky blue above and white on the ventral side. There are about 50-60 broad dark cross bands dorsally which taper down the ventral sides.

These markings diminish as age advances. The head in the adults is deep grey, while in the young it is black with a yellowish crescent mark which may be absent in the older specimens.

The head shields are broken up. There is no loreal shield. Behind the poison fangs are 14-18 maxillary teeth. Pre-ocular 1, post-oculars 2, supralabials 7-8, of which 3rd and 4th touch the eye and the 2nd is in contact with prefrontals. Four infralabials are in contact with genials : 31-43 scales on the neck.

The body is compressed posteriorly. The tail being flat, is shaped like a paddle. The body is rounded and the ventral scales are more or less reduced. Neural spines are developed in the caudal region and hypophyses are well-developed throughout the vertebral column.

These snakes live in water and are caught in fishermen's nets or due to ebb tide are left behind on the sea-shore. They are very good swimmers, but due to the absence of defined ventral scales, their movement on land is very clumsy. They disappear into water as soon as disturbed.

These snakes feed on fishes, eels and some other sea food. They are oviparous.

The poison of these snakes is neurotoxic and many a fisherman have complained of bites and effects of the poison. The only redeeming feature about their danger is that the bite takes place in sea where the venom gets diluted and as the fangs of these snakes are a bit behind, the snake therefore, does not always get a good chance to bite and inject the poison.

They are really a source of danger in the gulf of Penang where an antivenin has been now developed againsf their bites.

FAMILY : VIPERIDAE

The characteristic of this family lies in the fact that the fangs reach a high level of perfection. They have big curved fangs that are erectile and have a duct inside that opens at the tip of the fangs on one side. The fangs are movable and covered by a sheath and lie in repose at the side of the jaw (*Fig. 10*). There are two fangs in position with auxiliary buds at their base. When a fang is broken, the bud takes its place. The erection of the fangs is brought about by the palato-

maxillary arch in which the maxilla revolves like a hinge on the anterior end of the prefrontal *(Fig. 4)*. The poison causes swelling and intense pain at the site of bite and the other symptoms are discussed in Chapter 3. To this family belong vipers and pit vipers. All these snakes are viviparous, laying young ones directly.

Vipera Russelli

RUSSELL'S VIPER

Hindi : *Kander*
Bengali : *Chandrabora*
Gujarati : *Chital*
Kannada : *Baliwadak-hawu, Mandalatha-hawu*
Malayalam : *Ruthram mandli, Rakt-mandli*
Marathi : *Ghonas*
Tamil : *Mandli*
Distribution : All over India.
Length : 1,600 mm. in females; males are slightly longer.

This is quite a common poisonous snake in India which is often 150 mm thick and is heard to hiss loudly and continuously. It is brown with deep elliptical patches that run in three rows. A maximum of 37 dorsal (vertebral), 27 lateral elliptical patches were observed along with about 84 black spots on the ventrals *(Plate 41)*.

In newly born specimens the maximum patches are 25 dorsal and 22 lateral. The length of such snakes is about 240 mm and the weight about 14.3 gm. The length of an adult female was 1,100 mm, weighing 1,967 g.; the males being less bulky. There is a great variation in these patches in colouration as well as form. While normally it is brown, the South Indian vipers have a white border edged with black spots and even the central region forms an island. Some snakes caught in the Bombay region during the breeding season show a faint amber colour with faint brown spots. These are males and this colouration disappears after the breeding season. The patches are complete and separate anteriorly while the posterior ones seem to merge at the ends,

particularly in the dorsal region and more so in the younger specimens. The lateral patches do not have a defined elliptical shape, but look like a semi-circular tree top with a stem going down towards the ventral. Apart from these, there are black patches at the sides and a pair of deep brown spots on each ventral scale. The posterior of each scale below the head bears a black spot and the head bears a black patch below as well as behind the eye and beyond the parietal region upto the neck *(Plate. XI col.)*.

The head is triangular and the head scales on top are very small, imbricate and keeled. In fact, all dorsal scales are keeled, except those in the outer rows.

The snout is angulate and the nasal opening quite prominent. The eyes have a white border with golden iris and elliptical pupils. Supralabials 10-12, fourth is the largest and it does not touch the eye. A number of small scales run round the eye and about three rows of them separate the eye and the fourth supralabial.

This snake is found in rocky and bushy regions where the colouration on the skin is in keeping with the surroundings. The snake has been seen to go up bushes and small trees. It remains coiled with the head in the centre of the coil. With least disturbance, the tongue quivers, the head is raised, the body swells rhythmically and the snake hisses loudly and continuously. This hiss differs from that of a cobra in the sense that the cobra noise is intermittent and of a short duration, while in a Russell's viper, it is continuous and loud. It can strike even from behind. It hurls itself at the victim and the big fangs which are nearly 10 mm in length are pressed into the wound. Often the venom is sprayed while the snake opens the mouth, and withdraws the sheath before it hurls itself for biting.

The chief food of this snake comprises of small mammals like rats, mice, lizards and birds.

Mating was observed in our snake farm in July-August. The snake is viviparous and young ones were born in June next year. One female produced 97 young ones in three days. At birth they ranged from 110 to 130 mm and weighed from 1.45 gm. to 16 gm. The spots were rather confluent. The skin is cast on the first day, then on the third, seventh and later

after a month. The young ones try to feed after about 21 days. They are as poisonous in young age as adults, except that the amount of venom given out is rather small.

In captivity, these snakes have lived for about four years. The major illness in them was the infection of mouth, swelling of throat and head and death followed by pus formation in the area. The bite of this snake in the laboratory gave rise to a swelling and pain. The swelling continued for some days and then became dark at the site of bite (*Plate 22*). The victim survived with no other complications after a month of hospitalisation.

Echis Carinatus

SIDE WINDER OR SAW SCALED VIPER

Hindi : *Afai*
Bengali : *Bankoraj*
Kannada : *Kallu hawu*
Kashmiri : *Gunas*
Marathi : *Phoorsa*
Punjabi : *Afai*
Tamil : *Ratapambo Birianpankhu*
Distribution : Nearly all over India.
Length : 550 mm in both males and females.

This small poisonous snake (*Plate 38*) has a head that is triangular and bears a typical white arrow mark on a brown background. The body is greyish brown with a series of pale marks forming a curve over the body. These pale spots numbering from 25-31 are edged with dark spots all over the body. The under surface is white with black spots at the two ends of the scales. It is often met within a double curved position having the head in the centre and moving as a side winder and making a sawing noise by rubbing the scales.

The scales on the head are semi-circular and tiny as well as covering each other. They are strongly keeled. Behind the neck and at the sides, these keeled scales have serrations (*Plate. 18*). These when rubbed produce the noise when the snake moves. Supraoculars are very narrow and often broken. A ring of small scales is found round the big eyes which have

an elliptical pupil. Supralabials 10-12; two rows of small scales intervene between them and the eye. Caudal scales are 24-25 in a single row.

In the Ratnagiri district of Maharashtra, these snakes were collected in number. In 1876 the number of deaths due to snake bite in this district was 123, while an amount of Rs. 4,417 was spent towards collecting and destroying 1,40,828 of these snakes in one season. Even now they are collected from under the stones and in the red soil in Deogad taluq. About 5,000 of these snakes are gathered during monsoon, within a period of three months. A large number of these snakes are young. These viviparous snakes lay their young after the onset of rains in the month of July.

A large number of dissected Echis snakes have shown that the food of the snake consists of young frogs, lizards, snakes, scorpions and a large number of insects. In fact, the major part of the food content consists of the bodies of forficulid insects. These snakes have been reared on this diet. They are often seen on bare rocks even on hot days. In the deserts of Rajasthan, these snakes have been observed moving in the sands at night and probably hiding during the very hot period of the day. This snake from Rajashthan and Kutch area has a longer body and a heavier build. In Jaisealmer it is called *Pihuwa*.

On being disturbed, they strike, rising up to a height of about eight inches from the ground. Even while moving, the head is often flipped for a strike. Being small and lying under stones and in soil and also because of the colouration camouflage, people get bitten unawares.

These are poisonous snakes, but the amount of venom injected at a time is not sufficiently lethal to man. There are always complications after the bite. There is swelling, oozing and within 24 to 36 hours the man starts bleeding from gums, kidneys, nose, etc. Death is due to the complications which kill a man after a number of days. This is unlike the Cobra and Krait bite when the death is more or less on the same day. *Dipsas triagonata* is often mistaken for Echis. *Psammophis species* preys on this snake.

Ancistrodon Himalayanus

HIMALAYAN PIT VIPER

Kashmiri : *Pohur*
Malayalam : *Marayanali*
Distribution : Hilly region in the North and the Eastern part of India.
Length : 600 mm in male, the same length in female.

It is bluish brown dorsally with dark brown mottled or black spots appearing like crossbars with whitish interspaces all along the body. These bars are more prominent anteriorly in the vertebral region. One stripe extends from the eye to the temporal and even the neck region on either side. Mouth is grey with black spots. Ventral side brown with black and white spots.

The upper lip is slightly raised medially in the rostral region. Nasals divided into two, supralabials 5-7, third and fourth enlarged but not touching the eye. A small scale intervenes between supralabial and the eye. Post-oculars two, the last greatly enlarged. Supraocular enlarged sideways to form a shield over the eyes. Preoculars three. Pit in loreal in between pre-oculars. Eyes big, iris speckled in gold and the pupil is vertical. Scales are strongly keeled.

This snake is common in the Kashmir region and is found even at an altitude of 12,000 ft. One was recovered from an elevation of 16,000 ft. In Assam, NEFA, Sikkim and the Khasi Hills this snake is found at higher altitudes. In Kashmir, it is said to be responsible for causing death to cattle and sheep.

It is quite a timid snake and remains hidden under stones and with least noise or provocation, it rushes back to its shelter. Even when handled, it is not inclined to bite. It is no doubt a poisonous snake, which has well-formed erectile fangs under a sheath. The poison is probably haemotoxic.

It is viviparous.

Trimeresurus Gramineus

BAMBOO PIT VIPER

Hindi and Marathi	:	*Haranag*
Bengali	:	*Gechobora*
Gujarati	:	*Nagubiyo*
Malayalam	:	*Kattu mandli*

Distribution : Common in regions of thick bamboo growth in Peninsular India.

Length : 750 mm both in males and females.

This verdant green snake (*Plate. XII col.)* has a triangular head and three yellowish white longitudinal lines on the body; one vertical and two lateral. Prehensile tail is yellowish or reddish mottled with dark hues, greyish, with some grey spots ventrally. Head with blackish spots on imbricate scales and a speckled line from eye to neck. Eyes with a golden iris and a black vertical pupil.

This is a snake of low vegetation, normally met with in tropical and subtropical regions. It prefers bamboo vegetation or grass on which it is often seen reclining during daytime. The colour harmonises with the surroundings. It is sluggish, but when roused is capable of hissing and snapping at the intruder.

Supraoculars small, post-oculars 3, supralabials 11, of which none touches the eye though the third is enlarged. The pit is in the region near the first and second supralabials. This is a variously interpreted *(Plate 26)* organ; it is thought to be a chemoreceptor to judge the temperature variations or probably to inform the snake about the approach of the victim.

The food of this snake consists of small mammals, lizards or birds. It strikes its victim and holds it till it is dead. This is a viviparous poisonous snake, whose venom is probably vasotoxic.

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INDEX
(Technical)

ANILDAE, 91

BOIDAE 34, 91, 97, 109
Python, 6, 33-35, 58-59, 69, 81, 83, 97
molurus, 34, 75, 78, 97, 114
Eryx, 90, 97
conicus, 80, 97, 111, 112
johnii, 33, 78, 97, 112

COLUBRIDAE 85, 94, 97, 112
Dipsadinae, 97
Pareas, 97
macularius 97
moniticola, 97
Xenoderminae, 97
Stoliczkaia, 97
khasiensis, 97
Acrochordinae, 97, 112
Achrochordus, 98, 112
granulatus, 98, 112
Colubrinae, 98
Elaphe, 98
prasina, 98
frenata, 98
oxycephala, 98
radiata, 98
flavolineata, 98
helena, 98, 108, 113
taeniura, 98
hodgsoni, 98, 113
cantoris, 98
Ptyas, 34, 98
mucosus, 34, 66, 75, 78, 98, 114
Zaocys, 98
nigromarginatus, 98
coluber, 98
ventromaculatus, 98
rhodorhachis, 98
fasciolatus, 98, 115
gracilis, 98
diadema, 98, 115
arenarius, 98
Opheodrys, 98
doriae, 98
Liopeltis, 98
frenatus, 99
stoliczkae, 99
calamaria, 99, 116
rappi, 99
Coronella, 99
brachyura, 99, 111, 117
Oligodon, 99
cyclurus, 99
juglandifer, 99
albocinctus, 99
theobaldi, 99
venustus, 99, 117
travancoricus, 99
wood-masoni, 99
taeniolatus, 99
arnensis, 99, 112, 118
affinis, 99
brevicauda, 99
erythrogaster, 99
dorsalis, 99
Ahaetulla, 99, 113, 119
cyanochloris, 99
grandoculis, 99, 118
gorei, 99
bifrenalis, 99
caudolineolata, 99
tristis, 99, 119
Chrysopelea, 100

ornata, 100, 113, 119
paradisi, 100
Lycodon, 100
travancoricus, 100
jara, 100
fiavomaculatus, 100
mackinnoni, 100
aulicus, 100, 120
fasciatus, 100
Dinodon, 100
septentrionalis, 100
gammiei, 100
Dryocalamus, 100
nympha, 100, 115, 120
gracilis, 100
Sibynophis, 100
collaris, 100
subpunctatus, 100
saggitarius, 100
Natrix, 100
parallela, 100
nicobarensis, 100
khasiensis, 100
xenura, 100
piscator, 100, 121
himalayana, 100
stolata, 100, 116, 122
platyceps, 101
baddomei, 101
monticola, 101
Pseudoxenodon, 101
macrops, 101
Macropisthodon, 101, 117, 123
plumbicolor, 101, 117, 123
Xenochrophis, 101
ceratogaster, 101
Atretium, 101
schistosum, 101
Trachischium 101
montcola, 101
fuscum, 101
guentheri, 101
tenuiceps, 101
laeva, 101
Rhabodops, 101
olivaceas, 101
bicolor, 101
Blythia, 101
reticulata, 101
Xylophis, 101
perroteti, 101
stenorhynchus, 101
Boiga, 101
multimacuiata, 102
ochracea, 102
trigonata, 102, 118, 124
gokool, 102
ceylonensis, 102
quincunclata, 102
cyanea, 102
multifasciata, 102
cynodon, 102
forsteni, 102
dightoni, 102
Psammophis, 102
schokari, 102
condanarus, 102
longifrons, 102
leithi, 102, 120, 126
Psammodynastes, 102
pulverulentus, 102
Dryophis, 102
dispar, 102
fronticinctus, 102
nasutus, 102, 119, 124
prastinus, 102
pulverulentus, 102
parroteti, 102
Homalopsinae; 102
Enhydris, 102
sieboldi, 103
Cerberus, 103
rhynchops, 103, 121, 126
Gerardia, 103
prevostiana, 103
Fordonia, 103
leucobalia, 103

DASYPELTIDAE, 94, 103, 127
Elachistodon, 103
westermanni, 103, 121, 127
ELAPIDAE, 87, 94, 103, 129
Bungarus, 52, 58, 103, 130
bungaroides, 103
fasciatus, 58, 88, 103, 130
caeruleus, 52, 88, 103, 129
niger, 103, 131
lividus 103
walli, 103
Callophis, 103, 131, 132
melanurus, 84, 89, 97, 103, 124, 131

nigrescens, 98, 103, 125, 132
beddomei, 103
macclellandi, 103
bibroni, 103
Naja, 104
naja, 52, 88, 98, 104, 126, 133
oxiana, 104
kaouthia, 104
hannah, 49, 52, 84, 89, 98, 104, 129, 137

HYDROPHIIDAE, 82, 94, 104, 138
Laticauda, 104
laticaudata, 104
colubrina, 104
Kerilia, 104
jerdoni, 104
Praescutata, 104
viperina, 104
Enhydrinna 104
schistosa, 104
Hydrophis, 104, 138
nigrocinctus, 104
spiralis, 104
cyanocinctus, 104
obscurus, 104
stricticollis, 104
ornatus ornatus, 104
lapemoides, 104
mamillaris, 104
caerulescens, 104, 138
fasciatus 104
Lapemis, 105
curtus, 105
Microcephalophis, 105
gracilis, 105
cantoris, 105
Pelamis, 105
platurus, 105

LEPTOTYPHLOPIDAE, 90, 95
Leptotyphlops, 95
macrorhynchus, 95
blanfordi, 95

TYPHLOPIDAE, 85, 90, 95, 107
Typhlops, 32, 36, 88, 95, 102, 107
porrectus, 95
braminus, 78, 95, 107
psammeces, 95
thrustoni, 95
jerdoni, 95
tenuicollis, 95
diardi, 95
oatesi, 95
bothriorhynchus, 95
tindalli, 95
beddomei, 95
oligolepis, 95
andamanensis, 95
acutus, 95

UROPELTIDAE, 85, 91, 95, 108
Melanophidium, 95
punctatum, 95
bilineatum, 96
wynaudense, 96
Platyplecrurus, 96
trilineatus, 96
madurensis, 96
Teretrurus, 96
rhodogaster, 96
sanguineus, 96
Plecturus, 96
perroteti, 96
guentheri, 96
aureus, 96
canaricus, 96
Uropeltis, 96
nitidus, 96
ocellatus, 80, 89, 96, 103, 109
dindigalensis, 96
beddomei, 96
macrorhynchus, 96
wood-masoni, 96
macrolepis, 96
ceylonicus, 96
arcticeps, 96
rubromaculatus, 96
rubroblineatus, 96
phipsoni, 96
broughami, 96
myhendrae, 96
maculatus, 97
patersi, 97
liura, 97
melangoaster, 97
pluneyensis, 97
smithi, 97

Rhinophis, 34, 90, 97
sanguineus, 97
travancoricus, 97

VIPERIDAE, 86-87, 89, 94, 105, 139
Vperinae, 105
Vipera, 105
russelli, 5, 9, 34-36, 38-39, 42-45, 47-50, 52, 56, 59, 71, 78, 81-82, 84, 89, 105, 140
labitina, 105
Echis, 42, 48, 105, 142
carinatus, 3-4, 6, 34-35, 39, 40, 48-49, 52, 56, 61, 65-68, 70, 73-74, 76-78, 84, 90, 105, 142
Psedocerastes, 34, 100, 105
persicus, 34, 105
Crotalinae, 105
Ancistrodon, 105
himalayanus, 105, 136, 144
hypnale, 105
Trimeresurus, 30, 33, 106, 145
macrolepis, 106
mucrosquamatus, 106
monticola, 106
jerdoni, 106
malabaricus, 106
strigatus, 106
gramineus, 33, 81, 106, 145
stejnegeri, 106
popeorum, 106
cantori, 106
purpureomaculatus, 106
andersoni, 106
erythrurus, 106
albolabris, 106
labialis, 106

XENOPELTIDAE, 85, 91, 97
Xenopeltis, 97
unicolor, 97

INDEX

(General)

Abyssinia 28
Acetylcholine 45
Andenosine-triphosphate 46
Adrenal 69-71
Adrenalin 54-56
Afai 142-143
Agastya (Rishi) 26
Agimanyar 130-131
Ahi 25, 30
Ahiraj 59, 130-131
Ajanta 26
Ajgar 109
Ajitagad (medicine) 14
Allergic (Compound) 45
Alligators 1,32
Amphibia 57
Anant Chaturdashi 17
Ananta (Nag) 23, 30
Anaphylactic 53
Anaphylaxis 52, 54, 56
Andha samp 107
Antihistamine 55
Anticoagulant 45
Antigenic (compound) 45
Aphrodisiac 10
Arjuna 26
Arsenic 10
Arthralgia 9
Arthritis 9
Aryans 20
Ashoka (Emperor) 26
Asthma 9-10
Astika 14, 20
Asuras (demons) 20, 30
Atharwaveda 25
Autolysis 45-46
Ayodhya 30
Ayur Vedic System of medicine, 8, 10

Babylonians 28
Baldev (Lord Krishna's brother) 26
Baliwadak-hawu 140-142
Bamboo-pit-viper 81, 145
Bankoraj 142-143
Barbiturate 56
Basak Nag 21
Basioccipital Condyle 40
Basophil 49
Behra-panche 18
Bhadrapad 19
Bhagvadgita 31
Bhasma 24-25
Binocellate 88
Blood pressure 10, 45-46
Bodhi tree 26-27
Boidae 34, 91, 97, 109
Brahma 24
Brahmins 12, 18
Bridal snake 120
Brille 62
Bronze-back snake 118
Buccal Cavity 65
Buddha (Lord) 26-27
Buddhism 26
Buff-striped-keel back 122

Cancer 9
Cardiotoxin 45
Cat-snake 124
Central Research Institute, Kasauli 8
Cerebellum 72
Cerebral (hemisphere) 74
Cerebrum 74

Chamba 21
Chandrabora 140-142
Changu Narain 19
Checkered-Keelback 71, 121
Chera 114
Chhatra 30
Chhatrapati 30
Chelonia 1, 32
Chingi-hawu 124
Chital 140-142
Cholera 5, 10
Cholinesterase 11, 45
Chukshushrawa (one that hears by eyes) 62
Churta 124
Cloaca 66, 69
Coagulin 45
Cobra 5-6, 8-10, 12-13, 17-18, 21-31, 33-34, 36, 39, 42-48, 52, 57, 60-61, 63-64, 71, 78, 81, 83-84, 88-89, 104, 115, 133-137
Coccygodynia 9
Collumela auris 40, 59
Colubridae 85-87, 94
Copper-head snake 113
Coral snake 42, 132
Coral snake (slender) 131-132
Coramine 55
Crocodiles 1, 32
Crotamine 45
Cryotherapy 51
Curare 45-46
Cystic duct 65-66

Dalbergia aroborea 10
Damayanti (King Nala's Consort) 24, 110
Danav 107
Dasypeltidae 85, 94, 103
Debility 9
Dentry 48
Deoxyribonuclease 45
Deoxyribonucleotide 46
Devas (the gods) 20
Devistotram 25
Dhaman 114
Dharas 114
Dhritarashtra 23
Diadema 7, 115
Diaphragm 45
Dog-faced water snake 126-127
Domi 133
Dracovolans 1
Duodenum 65
Durkya ghonas 111

Earwig 59
Eisonophil 49
Elapidae 86-87, 94, 103
Elaschistodon westermanni (Indian egg eater) 127-128
Endothelium 46
Enzymes in venom 10-11, 44, 46-47, 58
Epilepsy 9-10
Erepsin 46
Erythema 53-54
Erythrocytes 45-46
Erythrocyte stroma 45
Eryx Johnii 33, 78, 80, 87, 97, 112
Eustachian tube 59

Falcons 13
Fangs 36-40, 65, 81, 87, 134
Fibrillar gel 46
Fibrin 45
Fibrinogen 45-46
Ficus religiosa (pipal tree) 22, 136
Foramen magnum 40
Forests 13
Frogs 13, 33, 45, 78, 80
Frontal (scale) 82

Gall bladder 66
Ganesh (Lord) 21, 25
Gargar 117
Garuda (divine eagle) 91, 26-27
Gavials 32
Gavtya 123
Gehuwa 133
Gekos 1, 32
Gharials 1
Ghonas 140-142
Glottis 66
Gobar panche 18

Godinaser 129
Gokhura 133-137
Golden tree snake 119
Grachurute 117
Greeks 28
Green-keel back 122-123
Gunas 142-143

Haemoglobin 45, 49, 72
Haemolysin 10, 45
Haemolys 46
Haemophilia 9
Haemorrages 9, 48
Haffkin Institute, Bombay 5-6, 8, 12-13, 34, 42, 52, 138
Hamadrayad (King Cobra) 137
Hanuman 25
Haranag 145
Himalayan pit-viper 144
Histamine 46
Hiuen Tsiang 30
Homeopathy 9
Hur-Hurra 122
Hyalase 55
Hya luronic acid 46
Hya luronidase 11, 45-46
Hydrophiidae 86-87, 94, 104
Hyoid 65
Hypochromia 49
Hypophyses 118, 120

Indian art and snakes 26-28
Indian culture and snakes 17-31
Indian egg eater 127-128
Indra (Chief of Devas) 25
Indru Nag 21
Infra labial 82, 109
Insomnia 9
Institute Butantan, Sao Pulo 7
Inter-orbital setum 40
Inter-nasal 82, 113
Intrathecal 55

Jacobson's organ 61
Jainism 26
Jamuna 20
Jana mejaya 14, 19-20
Jaratkaru (Rishi) 20, 26
Joldhorna 121

Kaatu pambu 113
Kadu 107
Kala Karayat 131
Kala Nagin 119
Kalia Mardan 20
Kalidas 26
Kaliyuga 24
Kallu hawu 142-143
Kambala 23
Kangra 21
Kankoti pambu 125-126
Kankoti pankhu 124-126
Karayat 129
Karinadan pambu 137-138
Karkotaka Nag 21-22, 24, 31
Karsh Nag 21
Kashyap 27
Katlawarian 120
Kawadi samp 117
Kawadivala 120
Kawus 22
Kerotin 34
Khus 28
King Cobra 33, 39, 43, 52, 57-58, 71, 89, 137-138
Kira 22
Kiras 22
Kirata 22
Kiri 22
Kiyai hawu 114
Kols (tribe) 19
Krait 6, 9, 36, 42-43, 48, 52, 57-58, 63-64, 71, 81, 83-84, 88, 103, 129-131
Krishna, Lord 20, 26, 30
Kshirsagar 21
Kulpar 113
Kumuda 26
Kumudvati 26
Kundalini 21
Kurudi pambu 107-108
Kuwar pambu 107-108

Laccrtalia 1, 32
Lacrymal bone 40
Lakshmi (Goddess of Wealth) 5
Lalitaditya 21
Lanka 25
Laryngitis 9
Larynx 47, 66
Lawudaga 124-126

Lecithinase 11, 46
Legends and mythologies (around snakes) 20-23
Lei flowers 14
Leprosy 8-10
Leptotyphlopidae 85, 90, 95
Leucoderma 10
Ligation 50
Lipid layers 46
Lizards 1,32, 59, 78, 80-81
Loreal 82, 85, 118-119
Lu Naga 28
Lunar eclipse 14
Lyphilised 44
Lymphocytes 49

Mahabharata 20, 25, 30-31, 110
Mahadeo, Lord 19-20
Mahavansha 26
Malam pambu 109
Mamba, African 77, 80
Mammals 1, 33, 41, 57, 59, 61, 72, 77, 81
Manasa (Goddess) 20
Mandalatha hawu 140
Mandli 140-142
Mandol 112
Maniyar 129
Mantras for snake-bite cure 11-12, 14-16, 137
Mannli pambu 111
Marayanali 144
Maxilla 36
Mayal 109
Medulla-oblongata 72, 74
Melia-azardirecta 135
Mental (scale) 82
Meru (mountain peak) 20
Mesozoic (period) 32
Metallic ions 44
Migraine 9
Mongoose 13
Monitors 1, 32
Monocellate 88
Monocytes 49
Moorkhan pambu 133-137
Mouse sarcoma 45
Musk 10

Nag 17-31, 133-137
Nag devta 19
Nag Panchami 6, 14, 17-20, 22, 30, 135
Nag Raj 137-138
Naga bana (snake arrow) 21
Naga Kanya (snake-maiden) 26
Naga Kings 20, 22, 26-27, 31
Naga Raja 20, 27-28, 30
Naga worship 18-20, 22-23, 28-31
Nagar havu 133-137
Nagi 28
Nagin 115
Nagnbiyo 145
Nala (King) 24, 110
Naneti 122
Nasal (scale) 82, 88, 108
Nasal bone 40
Necrosis 45, 48, 50
Neem (leaves) 135
Neerkoli 121
Neer mandli 121
Negus 28
Nehru, Jawaharlal 64
Netragodchi hawu 111
Neural leprosy 8-9
Neurtis 9
Neurotoxic (poison) 51
Neurotoxin 10, 44-46
Neutrophil 49
Nirguna (Shiva) 24
Nonaborah 126-127
Non-poisonous snakes see Snakes, Non-poisonous
Nucleases 45
Nucleotidase 11

Occipital 82
Occipital Condyle 40
Oesophagus 65-66, 78
Ophidia 1, 32
Ophio-amir o-acid-oxidase 45
Ophio-amino-Oxidase 45
Ophio-Oxidase 11, 46
Opium 10
Owls 13

Pacha-naga 123
Pachola pambu 124-126
Padmanabha 23
Palatine 41, 65
Pamboo 10
Pancreas 66

Pancreatic duct 65
Pandivad 120
Pani samp 121
Pansarp 126-127
Parietal (scale) 82
Parietal bones 40
Parikshit 21
Parotid gland 41, 57
Patal 26, 31
Peacocks 13
Pharynx 65-66
Phenyle 13
Phoenicians 28
Phoorsa 34-35, 142-143
Phosphadase 44
Phosphodiester bond 45
Phospholipase-A 45-46
Phosphorus Content 44
Pit viper 33, 81-82, 90, 144-145
Pleurisy 9
Pohur 144
Poison gland 36, 37, 41, 65
Poisonous snakes see Snakes, Poisonous
Polycephalous 30
Polyvalent antivenin 8, 13, 52-53, 57
Post ocular (scale) 82, 85, 89, 118-119
Pre frontal (scale) 82, 85, 113
Pre maxilla 33
Preocular (scale) 82, 85
Prittam 21
Priya pambur 109
Proteases 45, 47, 58
Proteolytic (activity) 45-46
Proteolytic enzymes 44, 46
Prothrombim 45-46
Pseudocrestes persicus 34
Pseudopodial 54
Pterygoid 39, 41, 65
Ptyas muscosus 34, 57, 63, 66, 75, 78, 80, 114-115
Phen samp 107
Pundarika 21
Puranas 20, 26
Pyrophosphatase 46
Python molurus 32, 78, 87, 109-111

Quadrate 33, 39, 60

Raat 131-132
Rabbits 5, 11-12, 72, 78
Racer snake 81, 115
Raghuvan 26
Raj samp 137-138
Rajat bansi 115
Rajatarangini 22
Rakshasi 25
Rakt mandli 140-142
Ramayana 25
Ratapambo 142-143
Rats 4-5, 13, 22, 45, 57-58, 78
Rattle snake 5,7-9, 29
Reptiles 1, 32, 57
Retina 9, 62
Rhinops 34
Rhynehocephalia 1, 32
Ribonu clease 11, 45
Rigveda 25
Ritugana 131-132
Rituparna 24
Rishabagad (medicine) 14
Rostral (scale) 82, 110
Russell's viper 5, 9, 34-36, 38-39, 42-45, 47-50, 52, 56, 59-71, 78, 81-82, 84, 89, 105, 140-142
Ruthram-mandli 140

Sabir Nag 21
Samudra manthan 20
Samudra sarp 138-139
Sand Boa 7, 33, 85-86, 111
Sand snake 126
Sanghamitra (Emperor Ashoka's danghter) 26
Sankh bangani 117
Sanskrit literature and snakes 23-26
Santan Nag 21
Santhal tribe 19
Sarpammuikan 133-137
Sarptoli 125-126
Saw-scaled viper 52, 56, 81, 142-143
Scapula 51
Sciatica 9
Scorpions 59, 81
Sea snake 35-36, 57, 80, 138-139
Seeta 25
Seeta ki lat 122
Serum Institute, Pune 8

Shankh Churh 137-138
Shankhapala 23
Shankhini 130-131
Shanta-Durga 19
Shesh Nag 18, 20-21, 23, 26, 31
Shields 35, 81
Shirala 18
Shiva, Lord 21, 24
Shiva Panchakshar 24
Shiva Shatkam 25
Shuchikabharan ras 9
Shuguwarian 120
Side Winder 134
Sinus venosus 73
Snake farms 43, 78
Snake-skin, Export of 6-7
Snake Charmers 6, 60, 63-64
Snake Venom 5-6, 8-11, 41-45
Snake venom, Constituents of 44-47
Snake venom, Symptom of 47-50
Snake venom, Treatment of 50-57
Snake, Classification and indentification of 79-144
Snakes (live), Exports of 6
Snakes, Non-poisonous 107-128
Snakes, Poisonous 129-144
Sphenopterygoid 41
Sphincter 14
Spinal Cord 74
Squamosal bone 40
Sravana (July-August) 19
Stapes 59-60
Stomach 65-66
Sulphathiazole 56
Supralabial 82, 85, 89, 118, 120
Supraocular 82, 85
Surasa 25
Surepambu 114
Sushrut 14
Suwarpankhu 120
Systolic 45

Takht Nag 21
Takshaka 21, 23
Tamool 10
Tanir pambu 121
Temporal muscles 41
Terrapins 32
Therban 122
Thermoreceptors 65
Thrombin 45-46
Throombo-Cytopaenia 49
Tibet 28
Tics 9
Toad 10,
Torana 27
Tortoises 1, 32, 77
Tourniquet 56
Trachea 69
Transpalatine bone 40
Trimeresurus gramineus 33, 145
Trinket snake 81,
Trypsin 45
Tuatara 1, 32
Tuberculosis 10
Turtles 1, 32
Typhlopidae 85-86, 90, 95
Typhlops 32, 36, 78, 86, 95

Udayana (King) 30
Udyoga parva 30
Ulupi (The snake nymph) 26
Unani system of medicine 10
Uterus 9
Utropeltidae 85-86, 91, 95

Valayan Kondali 138-139
Vanacogli 122
Varaha Mihira 22
Vas deferens 69-70
Vasuki 20-21, 23, 26, 30
Venom See Snake venom
Viperidae 86-87, 89, 94, 105, 139
Vishahari (poison remover) 20
Visha Kanya 19
Vishayam matra 10
Vishnu, Lord 19, 21, 24
Vishnu Purana 36
Vritrasura 25

Wanapambu 122
Wart snake 112
Whip snake (Common green) 33, 57, 75, 80, 124-126
Wolf snake 7, 117, 120

Yajurveda 25
Yoga Kundalini 21

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Written lucidly this book deals with Snakes which constitute an important part of Nature. Snakes must be preserved, not feared and destroyed. The author's personal observation on snake mythology and snake habits evince his keen insight into the history and life of these reptiles. The book will be of immense interest to budding herpetologists and laymen alike. The several colour plates and illustrations enhance the pictorial value of the book.

Dr. P.J. Deoras, gold medalist of the first Zoological congress and the award winner of the Dr. Bhansali lecture of Bomaby Medical union, was on the panel of experts of Plague at the W.H.O., and founder member of International Society of Toxinology. As Head of the Department of Entomology of Haffkine Institute, Bombay and Assistant Director, he founded the first snake farm in India in 1952. He was on the Presidium of the first International Congress on Snakes held at Caracas, Venezuala in 1976.

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